A novice primary school teacher’s attempt to teach mathematics for understanding: A self-study

Volume 1

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DEDICATION

In memory of Associate Professor Beth Southwell, who passed away on 1st August, 2007

An inspiration

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In memory of my mother Mattie, a lady of another era who felt that a Year 10 education was more than enough for a future wife and mother, and my father, Ivor, who dug his heels in and insisted his only daughter have the same educational opportunities as his sons. Growing up in tough times, he valued education and both he and Mum would have been proud to see me complete my thesis.

Dedicated to my first grandchild, Madeleine and those that come after her, I pray you learn to love learning.

And finally but foremost thanks to my Lord who led me to this place in my life, gave me this opportunity and sustained me through it all.

CERTIFICATE OF ORIGINALITY

I certify that the substance of this thesis has not been submitted for any degree or diploma in any institution of higher education and any help received in the preparation of this thesis and all sources used, have been acknowledged.

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TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

The emergence of constructivist epistemology, as the dominant educational philosophy, has been very influential on the current movement to improve the quality of education. NSW has seen the establishment of the NSW Institute of Teachers (NSW Government, 2004a), the development and publication of a generic set of standards for teaching (NSW Institute of Teachers, 2005a) and the implementation of the NSW Quality Teaching model of pedagogy since 2003. In mathematics education, philosophies of mathematics and mathematics teaching that are consistent with constructivism, are reflected in current and previous NSW syllabus documents as well as the standards document published by the Australian Association for Mathematics Teachers in 2002.

Within the context of these documents this research project investigated my efforts, as a novice teacher of primary school mathematics, to implement quality mathematics teaching. This research evolved from a Bachelor of Education honours project, which found that despite recently graduating from university preservice teaching courses which advocate teaching pedagogy based on constructivist learning theories, beginning teachers, along with their more experienced colleagues, use largely traditional methodologies in their mathematics teaching. From the narrative and analysis of my experience, it is my aim to demonstrate ways in which support might be implemented for beginning teachers in the subject area of mathematics. While the research literature has investigated beginning teachers, it has not done so in this unique and evolving context.

In this thesis the components of effective mathematics teaching were identified from the mathematics education literature, with a particular focus on the work of Doug and Barbara Clarke (Clarke & Clarke, 2004; Clarke, 1997) and linked to the more generic elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e). The resulting picture of the quality teaching of mathematics was then used to

analyse the data collected in video-taped lessons as well as the issues that emerged from my teaching diaries, daybook and programs, utilising the NVivo 2 (QSR, 2002) computer program.

The first year of teaching was undertaken on a part-time basis teaching only mathematics to a Year 2 class. The second year involved teaching a Year 4 class on a full-time basis. The impact of teaching full-time had an immediate impact on the time available to focus on mathematics teaching. Efforts to implement elements of best practice were subjugated by my need to survive the crushing workload associated with undertaking the programming, planning, teaching, assessing and reporting of all KLAs, each involving significant content.

In considering the implications of the findings of this self-study project it is important to consider the implications, not only for the support of novice teachers but also for the students they teach. Despite the positive experience of having taught part-time, improving on the skills developed in previous professional placement and casual teaching experiences including classroom organisation, behaviour management and programming, taking on a full-time teaching load with a new grade was overwhelming.

Implications regarding the types of support that would have been of benefit in assisting my efforts to do more than survive the early experiences of full-time teaching, and improve the quality of mathematics education experienced by my students are drawn. These include suggestions of how university courses might assist in bridging the gap between the vision of quality and the realities of teaching; reduced workload to allow significant opportunities for lesson preparation; formal mentoring, from someone other than a supervisor, and structures to support the establishment of collegial partnerships; preservice and inservice courses that move the teacher from an image of reform to identifying and developing a specific component in their own teaching; and the provision of innovative mathematics programs to support both beginning and experienced teachers in improving the quality of their mathematics teaching. Recommendations for further research are made.

CHAPTER ONE

Introduction to this study

Background to the study

Quality teachers and teaching

It is only recently that the focus of educational improvement has centred so clearly on the quality of teachers and teaching (NSW Department of Education and Training, 2003b; 2003e). Evidence based research strongly supports the importance of quality teachers and teaching, above all other aspects of education, in improving students' academic achievements, attitudes, behaviours and schooling experiences (Hattie, 2004; Rowe, 2003). Hargreaves (Hargreaves & Fullan, 1992b) argued that "the teacher is the ultimate key to educational change and school improvement" (p. ix). He maintained that teachers not only deliver curriculum, they also develop, define and reinterpret it. It is "what teachers think, what teachers believe and what teachers do at the level of the classroom that ultimately shapes the kind of learning that young people get" (Hargreaves & Fullan, 1992b, p. ix).

The quest for excellence in education is not new. In fact, it might be argued that all educational research, innovation and change would, at least in part, be motivated by a desire to advance the quality of education and improve learning outcomes for students. In the past twenty years or so, within the wider context of general reforms in Australian workplace practices (Schools Council, 1990), there have been moves to "define and promote" quality teachers and teaching (Mitchell, 2006, p. 39). Quality teaching has become a top priority, along with national benchmarking and reporting, for the Federal Government's involvement in schooling (Mitchell, 2006).

National initiatives

In 1988 the then Commonwealth Minister for Employment, Education and Training, the Hon J. S. Dawkins, released his policy document *Strengthening Australia's Schools* (Minister for Employment Education & Training, 1988), maintaining that “the quality of teaching is central to the quality of our schools” (p. 5). In 1989 the Schools Council produced *Future quality: An issues paper* (Schools Council, 1989) for the National Board of Employment, Education and Training. This paper argued that the key to strengthening Australia’s schools is to strengthen the quality, morale and status of teaching services. This document covered matters relating to the selection, initial training and professional development of teachers.

In 1990 The Schools Council published *Australia's Teachers: An Agenda for the Next Decade*, a paper that linked the quality of individual teachers to a set of conditions considered important in promoting and sustaining the quality of teaching generally. It set out a long-term agenda for developing more varied career paths for teachers and for recognising, supporting and rewarding improved classroom performance.

At the time this document was published the National Project on the Quality of Teaching and Learning (NPQTL) was being initiated by the Commonwealth Government (Schools Council, 1990) as part of its Good Schools Strategy (Rowe, 2003). This was a three year research and development venture that arose out of the award restructuring negotiations of the period up to 1991. It was part of a wider movement to develop sets of competencies in a range of professions and other occupations (NPQTL, 1996). One of the major outcomes of the NPQTL was the publication of the *National Competency Framework for Beginning Teachers*, published in 1996 which will be briefly detailed in this section.

In 1992 the NPQTL hosted a conference of representatives from the Australian education community to consider ways of achieving a national framework for teachers’ qualifications and professional standards (NPQTL & National Board of Employment, Education and Training, 1992). The delegates of this conference concluded that, within the Australian education community, there was strong support for developing a model for a National Teaching Council of Australia. Conference participants agreed that a national professional body “would enhance teachers’ status and provide, not only an identity for the profession, but a forum for teachers to express their views in the professional environment" (NPQTL & National Board of Employment, Education and Training, 1992, p. 11). They addressed the issue of developing national competency standards in teaching as a requirement for membership of such a professional body.

In 1996 the NPQTL released the *National Competency Framework for Beginning Teachers* which described in generic terms what beginning teachers should know and be able to do. It was "an attempt to establish a national basic teacher qualification and to improve portability across states and territories" (Mitchell, 2006, p. 41). However, it raised concerns about the dangers of reducing the complexities of teaching, including its "thinking, creative and intuitive elements" (Mitchell, 2006, p. 41) to a list of competencies (Hattam & Smyth, 1996; Mitchell, 2006) driven by the economic-rationalist perspective dominating the political and economic climate in Australia (Hattam & Smyth, 1996).

In April 1999 The State, Territory and Commonwealth Ministers for Education met as the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) and endorsed a new set of National Goals for Schools in the 21st century, known as the Adelaide Declaration (MCEETYA, 1999). These goals were described in three categories: ensuring children are prepared to undertake responsible roles in society; that the curriculum is comprehensive; and to ensure schooling advances social justice.

In 2000 the Australian Government Quality Teacher Programme (AGQTP) was established as the Australian Government's "flagship initiative for improving the quality of school teaching and leadership" (AGQTP, 2006, para. 1). Its objectives were to equip teachers with the skills and knowledge necessary for teaching in the 21st century, provide national educational leadership in areas of high priority, and improve the standing of school teachers and leaders. Within this framework the AGQTP has funded research and development projects both nationally and at State and Territory levels.

Subsequently the Teacher Quality and Educational Leadership Taskforce was established in 2001 and in 2003 it produced the *National Framework for Professional Standards for Teaching* (MCEETYA, 2003). This framework received State, Territory and Federal Education Ministers' endorsement and is a "guide and key point of reference" (MCEETYA, 2003, p. 1) for any groups undertaking work on standards for teaching.

In 2004 the Australian government funded the establishment of the National Institute of Quality Teaching and School Leadership (renamed Teaching Australia in 2005). This organisation has been established as the national body for the teaching profession. Its recent publication *Our Profession – Our Future* (Teaching Australia - Australian Institute for Teaching and School Leadership, May 2006) claims to be setting the scene for the development of national professional standards.

NSW initiatives

This is the national context in which the NSW State Government and NSW Department of Education and Training have been developing policies and projects to improve the quality of teachers and teaching in NSW. Some of these initiatives have received funding from the Commonwealth Government's Quality Teacher Programme (AGQTP: NSW, 2006). The two major initiatives of the NSW Government are the establishment of the NSW Institute of Teachers through State Government legislation (NSW Government, 2004a) and the NSW model of pedagogy (NSW Department of Education and Training, 2003e) promoting quality teaching in NSW schools.

The NSW Institute of Teachers

The NSW Institute of Teachers was established as a consequence of the Institute of Teachers Act 2004 No 65 being passed through the NSW Parliament in July 2004 (NSW Government, 2004a). This organisation has been established to institute formal standards of teacher quality. Its role is to monitor and moderate the processes for meeting these standards; to advise and assist employers in accrediting teachers against the standards; to make recommendations to the NSW Minister of Education and Training regarding the provision of initial and further teacher education; and to monitor and advise the Government on issues related to teacher quality (NSW Government, 2004b).

In 2005 the NSW Institute of Teachers, using the Australian Government's document *A National Framework of Professional Teaching Standards* (MCEETYA, 2003) as a point of reference, published the *Professional Teaching Standards* (NSW Institute of Teachers, 2005a). The standards describe "what teachers need to know, understand and be able to do as well as providing direction and structure to support the preparation and development of teachers" (NSW Institute of Teachers, 2005a, p. 2). It addresses three professional domains which describe the nature of teachers' work: professional knowledge, professional practice and professional commitment (MCEETYA, 2003; NSW Institute of Teachers, 2005a), detailing essential elements of teaching competence. The standards relate to the four key stages of teacher development outlined in the framework: graduate teacher, professional competence, professional accomplishment and professional leadership.

For the purposes of this study the most relevant stage of the standards is that of graduate teacher. The expectations of graduate teachers are that they:

- are beginning their teaching career in NSW
- have undertaken an approved program of teacher preparation or its equivalent
- possess the required knowledge, skills, values and attitudes to plan for and manage successful learning
- are equipped to engage in and negotiate the process of ongoing professional learning

- identify their development needs and seek advice and support from colleagues
- have high expectations of themselves as professional learners and for the learning of their students
- support students' achievement of the highest possible educational outcomes

"[Graduate teachers] have the commitment, enthusiasm and interpersonal skills to assume a professional role within schools and the broader communities and to contribute to the operations of a school as a whole" (NSW Institute of Teachers, 2005a, p. 2).

While the *Professional Teaching Standards* (NSW Institute of Teachers, 2005a) provide a set of criteria for registering, monitoring and managing the quality of teachers, it is not designed as a tool for the professional development of teachers. Using the current research on quality teaching the NSW Department of Education and Training has developed and implemented a package of materials specifically designed to be used by teachers, both individually and within whole school contexts, as a tool in their professional development, to encourage reflective, high quality teaching practices (NSW Department of Education and Training, 2003a, 2003b, 2003c, 2003e, 2004a).

The development of a model of quality teaching in NSW

The NSW model of pedagogy (NSW Department of Education and Training, 2003e) was introduced in 2003. The model is research-based and consists of three domains: intellectual quality, quality learning environment and significance. Each of the three dimensions of the model is comprised of six elements, with details provided of how each element will be evidenced in both the classroom and assessment tasks. Each element in the model is measured on a coding system of 1-5, with descriptors of observable aspects of classroom practice provided (NSW Department of Education and Training, 2003a). A DVD presentation (NSW Department of Education and Training, 2003d) of a range of K-10 lessons is presented to give teachers experience in using the coding system (NSW Department of Education and Training, 2003c) before applying it to their own lessons.

Teachers are encouraged to utilise the model in the design and administration of assessment tasks and are provided with *An Assessment Practice Guide* (NSW Department of Education and Training, 2004a) to assist in this process.

Quality teaching of mathematics

Within the context of mathematics education there have also been significant efforts to improve the quality of teaching and learning. In 1989 the NSW Department of School Education released the *Mathematics K-6* (NSW Department of School Education, 1989) syllabus. This document was based on current well-researched learning theories and was in line with other documents released in the 1980s and early 1990s, throughout countries in the western world, encouraging reform of mathematics teaching. More recently the *Mathematics K-6 Syllabus* (Board of Studies NSW, 2002) has been released and it too reflects these reforms. Research indicates that students taught using the methodologies advocated in these documents develop deeper conceptual understandings and perform better than students experiencing traditional mathematics teaching (Newmann, Marks, & Gamoran, 1996; Sebela, 2000; Wood & Sellers, 1997).

My circumstances

I came to this study as a mature age beginning teacher whose particular interest in the Mathematics KLA (Key Learning Area) was piqued through university courses in mathematics teaching and content. In these courses I encountered ‘problem solving’ approaches to teaching mathematics for conceptual understanding, rather than the teaching of procedures and routines. My previous experiences of mathematics education had been in my own primary school, high school and tertiary education, many years ago, and they had little in common with what I encountered in these courses. I had seen a more ‘hands-on’ approach to mathematics education in my own children's primary schools, however, the approach I encountered at university involved more than the provision of concrete materials for the children to manipulate.

I was quite a successful mathematics student in both primary and high school. I enjoyed playing with numbers, following routines, using algorithms and formulas. My understanding of the mathematics undergirding the routines, algorithms and formulas was not an issue until the latter years of high school, where I needed to have some understanding of what these formulas represented in order to choose the correct formula to use in a particular question. Despite this, I still did reasonably well completing 2F mathematics in the Higher School Certificate (HSC). I did, however, feel frustrated that the two students in my class completing First Level mathematics seemed to understand the mathematics behind the work we did. It was beyond me. However, I would not be put off and despite the frustration, I still enjoyed mathematics.

When I commenced my Bachelor of Education in 1974 I had to choose one subject in which to major. I chose mathematics, and completed three units of a tertiary level mathematics course, unrelated to my Primary Education Course. I struggled to pass these courses, in part, due to my lack of commitment in a really busy and exciting time of life, in part, due to my lack of conceptual understanding of the mathematics involved in the courses. I remember my frustration with the lecturer who seemed to 'hook into' a handful of students who metaphorically went with him to what I called 'maths land'. They were obviously having a great time, you could see it by the looks on their faces and their palpable enthusiasm, but they left the rest of us struggling with our formulas. It wasn't that I couldn't remember the formulas, or that I couldn't use them, I just didn't have enough understanding of the mathematics to know which one to use, when and where. After battling on for three units of calculus and algebra I decided to pursue my other interest, and completed an Art major. In the excitement of getting married, building a house and planning a family, I did not complete this course.

Hence, 17 years and four school age children later, I applied to re-enter tertiary education and complete my teaching degree. My experiences in the mathematics content and pedagogy courses left me wondering what sort of success I might have experienced as a mathematician, if I had been taught using these approaches. I wondered if I too might have been able to go to 'maths land' with those other lucky ones. I was convinced that as a primary school teacher, I would do whatever I could to ensure my students developed deep conceptual understandings of mathematics and didn't just manipulate numbers.

I completed my Bachelor of Teaching in 1997 and undertook my honours project part-time throughout 1998 to 2000. My experiences, as a mother of primary school children and a student teacher, left me with the conviction that many primary school teachers were teaching mathematics in ways that were very similar to my own primary school education. I suspected that while they may be utilising concrete materials in their lessons (other than Cuisenaire rods, which are my only memory of concrete materials in my schooling), they were teaching procedures and routines rather than supporting a conceptual understanding of mathematics.

I was also aware that many of my fellow preservice primary school teachers were not confident in their own mathematical understandings and held negative attitudes to their own school experiences in mathematics. I could see that many of them, like me, were experiencing a totally different approach to mathematics than they had experienced as students, and many were keen to implement it in their own classrooms.

I was curious as to the beliefs, attitudes and practices of primary school teachers, both novices and experienced. Was there a difference in how more recent graduates of university courses, like mine, taught mathematics? Did teachers feel confident in how they taught mathematics? With these initial questions I undertook my honours research project investigating the beliefs, attitudes and teaching practices of primary school teachers in mathematics (Forrester, 2000). One of the key findings of that study was that even relatively new teachers embrace largely traditional methodologies in their approaches to mathematics teaching, as do their more experienced colleagues.

While my research gave depth and breadth to my emerging vision of teaching mathematics for understanding, I had no experience in teaching mathematics. I had read about the benefits of teaching in a way that promoted a conceptual understanding of mathematics (Yackel, Cobb, & Wood, 1993b). I had also read of the difficulties of teaching in this way (Davis, 1997; Goldin, 1990; Smith III, 1996). I had read with great interest one experienced teacher's efforts to teach mathematics for understanding (Ball, 1993a, 1993b) and the difficulties and successes she encountered. I wondered what it might be like to be committed to teaching mathematics for understanding as a beginning teacher. Whether, as a mature age beginning teacher, I would have more to overcome in terms of a more traditional experience in my own education. I knew I would have to contend with algorithms that, prior to that lecture and two hour tutorial, I had only experienced as a mother, trying and failing to help my children develop a deep understanding of these concepts. Were there areas in which I didn't have a conceptual understanding? I didn't know what I didn't know.

Therefore, I began my PhD in 2001, never having taught mathematics, with a desire to teach it for conceptual understanding and the opportunity to study myself undertaking this process. This study then is an account and an analysis of my journey.

Significance of the study

The decline in enrolments in mathematics and science faculties has seen an increasing interest in the quality of teaching in these subjects, particularly at the primary school level, where "many of the attitudes to learning and to particular subjects are formed and reinforced" (Falle, Lawrie, & Squire, 2002, p. 4). Glenn (2000), in the foreword to *Before it's too late: A report to the* *nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, maintained that the way to interest students in these subjects is “through teachers who are not only enthusiastic about their subjects, but who are steeped in their disciplines and who have the professional training – as teachers – to teach those subjects well” (p. 5).

Clements (2003) maintained that mathematics, taught traditionally, contributes to the “propagation of values about mathematics and mathematics education that are not consistent with contemporary theories and ideals in education” (p. 637) and have detrimental effects on students’ self concepts in mathematics. Despite the introduction of reform-based syllabi (Board of Studies NSW, 2002; NSW Department of School Education, 1989) and standards (NCTM, 1989, 2000) many teachers continue to utilise largely traditional models of teaching and learning in mathematics (Forrester, 2000; Mewborn, 2000), Mewborn (2000) arguing that the reforms introduced with the NCTM Standards (1989) had made little impact at the classroom level in American schools.

In NSW, one effort to address this problem has been the provision of preservice mathematics education courses, based on constructivist principles, designed to encourage the development of teaching practices consistent with both the *Mathematics K-6* (NSW Department of School Education, 1989) syllabus and the more recent *Mathematics K-6 Syllabus* (Board of Studies NSW, 2002). While many preservice primary school teachers enter these courses with negative attitudes to, and traditional conceptions of, mathematics education (Biddulph, 1999; Mayers, 1994; Schuck, 1995, 1996), success has been evidenced in changing their beliefs and attitudes to mathematics and mathematics teaching (Biddulph, 1999; Mayers, 1994; Schuck, 1995). However, translating the substance of these courses into effective teaching practices has not been as successful, with many novice teachers embracing largely traditional methodologies in their approaches to mathematics teaching, as do their more experienced colleagues (Forrester, 2000).

This study is significant in providing a view, from the 'inside', of a novice teacher's attempts to utilise teaching practices consistent with these reforms. In undertaking this study a rare opportunity was available to investigate, as a researcher, the experiences of beginning to teach primary school mathematics, while attempting to implement reform based pedagogies to support students' understanding, as a novice teacher. Endeavouring to construct a form of teaching practice consistent with mathematics education reform provided the opportunity to study what this involves as a novice. It enabled access to aspects of the experience that were invisible to an outsider; an insight into the feelings and tensions engendered by the successes, failures, frustrations and joys of trying to teach mathematics for conceptual understanding. As a researcher I have tried to identify what I needed, as a novice teacher of primary school mathematics, in order to teach mathematics for understanding. What would have better prepared me for beginning to teach primary school mathematics? What would have supported me in my early efforts to teach mathematics in a way consistent with quality teaching?

While in some aspects my experiences are unique to me and my circumstances, in important ways they are common to many beginning teachers as is evidenced in this thesis. As a researcher I have gained a deep appreciation of the complexities of teaching mathematics for understanding, utilising reform-oriented pedagogy, as a novice primary school teacher. This thesis provides a window into this process, not previously available in the research literature. It has value for informing preservice and inservice education and those responsible for policy regarding teaching and teacher education.

Organisation of the thesis

This thesis begins with a review of the literature pertaining to the quality teaching of mathematics in Chapter 2. In this chapter an attempt has been made to identify connections between the components of effective mathematics teaching as evidenced in the mathematics education literature and the generic elements of quality teaching as detailed in the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

Chapter 3 examines the beginning teacher literature, identifying influential factors in the process of becoming a teacher, stages of teacher development and the concerns and problems commonly experienced by novice teachers. It highlights the research into the experiences of beginning and experienced teachers in trying to implement best teaching practices in mathematics, establishing the lack of first-person inquiry, from the perspective of a novice, into this process.

The methodological rationale for the study is presented in Chapter 4 with research methods described and justified. The context of the study is described and methodological changes detailed.

In Chapters 5, 6 and 7 an analysis and discussion of the data is presented. Chapter 5 focuses on the issues emerging from the data collected in the first part-time year of teaching, while Chapter 6 details those emerging from the second full-time year of teaching. Chapter 7 compares, contrasts and evaluates the experiences in both years of teaching. It highlights the major constraints and issues that emerge over the period of the study, as a novice trying to teach mathematics in ways consistent with the literature on high quality mathematics pedagogy.

Chapter 8 offers conclusions and suggests implications arising from this study, outlining its limitations and recommendations for further research.

Beginning teacher terminology

Within the NSW context, teachers graduating from university are categorised as ‘graduate’ teachers (NSW Institute of Teachers, 2005a) until they satisfy the requirements of registration when they are considered to have attained the standing of ‘professional competence’. However, in terms of reviewing the literature on beginning teachers, the terminology used is quite diverse. To avoid ambiguity it is necessary to clarify how it will be utilised in this thesis.

A large body of the literature examines factors relating to students undertaking teacher education courses and professional experience placements, and these student teachers are sometimes referred to as novice, beginning or neophyte teachers (Brown & Borko, 1992). While this fits with Kagan’s (1992) conclusion that preservice teaching experiences and the first year of teaching are a single developmental stage, it can be confusing when using these same terms to describe teachers in their first years of classroom teaching following their completion of a teaching qualification.

Veenman (1984) defined a beginning teacher as being in the first three years of teaching after having received part or full qualifications to teach. Feiman-Nemser (1983) suggested that in their fifth year "most teachers feel confident, secure and professionally competent" (p. 162). Huberman (1985) claimed that the problems experienced by beginning teachers are generally not solved within three years and could take five years or more of experience to solve. With this literature in mind, Goddard and Foster (2001) more recently defined novice or neophyte teachers as having no more than five years of classroom experience. Considering these definitions it has been decided that for the purposes of this study, the terms ‘novice’, ‘neophyte’ and ‘beginning’ will refer to teachers in their first five years of teaching after having received a recognised teaching qualification. ‘Graduate’ teachers are those who have recently completed their preservice education courses and would also fit within the category of ‘novice’, ‘neophyte’ or ‘beginning’ teacher. These terms do not refer to university students undertaking professional experience placements as part of their teacher preparation programs. These people are referred to as ‘student’, ‘preservice’ or ‘trainee’ teachers.

Definition of terms and abbreviations

2F mathematics: Level 2 Full mathematics – second highest level of mathematics available in completing the HSC at the time I completed the HSC, the highest being 1st level.

Acceleration or accelerated progression: "The promotion of a student to a level of study beyond that which is usual for their age" (Board of Studies NSW, 2000, p. 4). This may be undertaken in one or more KLAs.

Beginning teachers: Teachers who are qualified and within the first five years of teaching.

Black Line Master (BLM): Printed resources with permission to make multiple copies for use in classrooms.

Creative Arts: A KLA that incorporates visual arts, music, drama and dance.

Gifted and Talented (G & T): Gifted students are those with "the potential to perform at a level considerably superior to one's age-peers in one or more domains of ability" (Gagne cited in Board of Studies NSW, 2000, p. 6). Talented students evidence "significantly superior achievement or performance in one or more fields of human performance" (Gagne cited in Board of Studies NSW, 2000, p. 6). In NSW schools programs are designed to nurture these children through a variety of means, including accelerated progression (Board of Studies NSW, 2000).

Graduate teachers: In NSW this refers to teachers who have recently completed their preservice education course who have not yet been accredited as attaining the 'professional competence' stage of teaching. In some of the literature the term 'graduate' is used to refer to teachers in any context who have recently graduated from their preservice courses.

Higher School Certificate (HSC): Public examination concluding the high school years in NSW.

Human Society and Its Environment (HSIE): A KLA formerly known as Social Studies.

Key Learning Area (KLA): A term used in NSW schools to refer to the different subject areas. In primary school the KLAs are English, Mathematics, S & T, PDHPE, HSIE, Creative Arts and Languages.

Multibase Arithmetic Blocks (MAB): Base 10 materials are commonly available in infants and primary schools.

Neophyte teachers: Teachers who are qualified and within the first five years of teaching.

Novice teachers: Teachers who are qualified and within the first five years of teaching.

Pedagogy: The science of teaching.

Personal Development, Health and Physical Education (PDHPE): A KLA encouraging the development of an understanding of health and the development of a healthy lifestyle.

Preservice teacher: A student in a recognised course providing teacher education.

Reform-oriented mathematics: Refers to teaching that is informed by the latest research and pedagogy. While the term arises in a particular year, in this thesis it is used to include 'latest developments'.

Relief from face-to-face teacher/teaching (RFF): Release from classroom teaching provided by another teacher, referred to as an RFF teacher.

Science and Technology (S & T): Science and Technology incorporates both subjects including the use of computer and communication technology.

Special Teacher Learning Difficulties (STLD): A teacher who specialises in learning support for students experiencing difficulties, particularly in reading and mathematics.

Stage: In primary schools in NSW there are four stages. Early Stage 1 = Kindergarten; Stage 1 = Years 1 and 2; Stage 2 = Years 3 and 4; Stage 3 = Years 5 and 6.

Student teacher: A student in a recognised course providing teacher education.

Trainee teacher: A student in a recognised course providing teacher education.

CHAPTER TWO

Quality Teaching of Mathematics

Introduction

The past fifteen years have seen the emergence of a movement to improve the quality of education, with a clear and particular focus on improving the quality of teachers and teaching (Mitchell, 2006). Nationally we have seen the establishment of Teaching Australia which has a mandate to develop a set of national standards for all teachers (Teaching Australia - Australian Institute for Teaching and School Leadership, May 2006). In NSW we have seen the establishment of the NSW Institute of Teachers (NSW Government, 2004a), the development and publication of a generic set of standards for teaching (NSW Institute of Teachers, 2005a) and the implementation of the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

In the recent history of mathematics education, as in all areas of education, the emergence of the constructivist epistemology, as the dominant philosophy, has influenced moves for change (Matthews, 2000; Zevenbergen, 1996). Constructivist language has been used in all major reform documents in the USA, Australia and the United Kingdom (Zevenbergen, 1996). Philosophies of mathematics and mathematics teaching that are consistent with constructivism, are reflected in the current and previous NSW syllabus documents (Board of Studies NSW, 2002; NSW Department of School Education, 1989), as well as the standards document published by the Australian Association for Mathematics Teachers (AAMT, 2002).

This review of literature focuses on the influence of constructivism on the reform movement in mathematics education and the movement for quality teaching. From the literature, the components of effective mathematics teaching are identified and links to the more generic elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) are established.

The emergence of constructivism as a dominant influence in education

Theories of learning

The question of how people learn has been a focus of research and debate for much of the last century. In order to comprehend the current quality teaching movement, it is necessary to have an understanding of the different learning theories that have influenced education. Lefrancois (2006) classified them into three categories, behaviourist, humanist and cognitive theories.

Behaviourist views of learning can be traced back to the work of Ivan Pavlov. In the early years of the 20th century Pavlov, as part of his research on digestion, observed that dogs began to salivate at the sight or sound of the assistants who normally fed them, even when the assistants did not feed them (Eggen & Kauchak, 2007). He followed up this observation with a series of experiments, thereby opening up a new field of study called classical conditioning. His work was very influential in the development of what became known as behaviourism, through the subsequent work of theorists such as Watson, Thorndike and Skinner (Lefrancois, 2006). From a behaviourist perspective, “learning is a relatively enduring change in observable behaviour that occurs as a result of experience” (Eggen & Kauchak, 2007, p. 164). Behaviourist theories of learning are associated with stimulus-response events and with the effects of repetition and reinforcement (Lefrancois, 2006).

Bandura extended behaviourist learning theories to include, not only the environment and behaviour, but also learners’ beliefs and expectations (Eggen & Kauchak, 2007). He called this a social cognitive theory (Bandura, 1986), which is also known as social learning theory (Eggen & Kauchak, 2007). Eggen and Kauchak (2007) compared Bandura’s theory to previous behaviourist understandings, explaining that social cognitive theory rejects the idea that learning is focused in behaviour. Social cognitive theory maintains that learning is a mental process that may or may not be evidenced in behavioural change. Whereas behaviourism focuses on the affect of the environment on behaviour, social cognitive theory suggests that behaviour, the environment and personal factors all influence each other. Social learning theory asserts that reinforcement affects learners' motivations, rather than directly affecting their behaviours. Central to social cognitive theory is the notion that people learn through interacting with and observing each other. Hence, theorists who espouse social learning theory view modelling as a powerful learning tool (Eggen & Kauchak, 2007).

Humanist views of learning, as described by Lefrancois (2006) place prime importance on the uniqueness of the student and the attitude of the teacher. They object to the process-product view of learning and demand a student-centred learning environment, where it is recognised that each person is at the centre of a continually changing world of private experience, which only they can know. They assert that individuals are motivated by the need for self-actualisation. Self-actualisation is described as the process of becoming oneself, reaching one's potential and recognising one's own worth and dignity.

Cognitive learning theories developed, in part, as a response to behaviourism's inadequate explanation of learning, particularly in complex situations such as language development and problem solving (Eggen & Kauchak, 2007). They differ fundamentally from behaviourist theories in that learners are seen as actively involved in constructing their own understandings, rather than passively responding to their environment. While these theories acknowledge the role of environmental influence, they emphasise internal and mental processes in attempting to understand learning (Eggen & Kauchak, 2007).

The work of Jean Piaget

As a genetic epistemologist, Piaget developed an interest in the growth of knowledge in people through the observation of his own children (Eggen & Kauchak, 1997). His research was very different from that of the behaviourist tradition which dominated western education and psychology at the time. Looking at intelligence and knowledge as biological functions (von Glasersfeld, 1990), Piaget investigated how children adapt to their environment. This led to the classification of the stages of children's cognitive development (Lefrancois, 2006).

Piaget's classification and description of children's stages of development have had widely accepted applications for education and curriculum design (Eggen & Kauchak, 2007). He described the qualitative changes in children's thinking from one stage to another, and argued that experiences in one stage form the foundation for movement to the next. Piaget also asserted that, while all children pass through these stages, individual children pass through them at different rates and ages, depending on their maturation and social experience (Eggen & Kauchak, 2007). Children in K-2 are generally in the preoperational stage, while in Years 3-6 they will normally be in the concrete operational stage. Children in the preoperational stage are egocentric, being unable to consider the world from perspectives other than their own. They are able to perform mental operations such as classifying objects and their concepts are concrete, having limited notions of abstract ideas. Children within the concrete operational stage are able to think logically about concrete objects and are more able to understand the views of others (Eggen & Kauchak, 2007). As a result of their development, children in both of these stages require learning activities based in concrete experiences, a concept reflected in both the current and previous mathematics syllabi (Board of Studies NSW, 2002; NSW Department of School Education, 1989) and associated *Sample Units of Work* (Board of Studies NSW, 2003).

Piaget saw development as "the orderly, adaptive changes in learners that result from a combination of experience, learning, and maturation" (Eggen &

Kauchak, 2007, pp. 30-31) beginning at birth and continuing until death. He maintained that people organise their experiences of the world into their own cognitive structures (Ernest, 1994), which he called schemas. Equilibrium, or a state of balance, is experienced when people's schemas adequately explain the events they observe. When they do not, people experience disequilibrium. This results in a drive to search for a new and better understanding in order to restore equilibrium. When the person adapts their schemas to accommodate the new experience, equilibrium is restored (Eggen & Kauchak, 2007). In this way, people construct their own understanding. Hence, learning is an active process (Eggen & Kauchak, 2007) which is generally provoked by a situation, rather than being spontaneous (Piaget cited in Steffe & Tzur, 1994).

Piaget's research and his developmental and learning theories had a significant impact on teaching in the 1960s, which saw the emergence of discovery and active learning models (Elkins, 1977) as an alternative to traditional, transmission of learning, teaching models.

The theories of Lev Vygotsky

Vygotsky was a Russian psychologist who died in 1934 (Lefrancois, 2006). Due to the nature of Russia's relationship with the West, his work did not become widely known in Western education until the 1980s. Vygotsky emphasised the critical role of social and cultural influences on intellectual development (Confrey, 1995; Eggen & Kauchak, 2007; Steffe & Tzur, 1994). According to Vygotsky, all intellectual development evolves from the social to the individual (Confrey, 1995), with language and social interaction playing a vital role in this process (Eggen & Kauchak, 2007). Language provides cognitive tools that allow people to think about the world and to solve problems. It also enables individuals to interact with others, and in so doing, to trade ideas, resulting in the sharing and transmission of culture. Furthermore, it facilitates reflection and enables people to regulate their thinking. Vygotsky also maintained that children learn by doing, that is, by becoming involved in meaningful activities with more knowledgeable peers or adults (Eggen & Kauchak, 2007; Souviney, 1994).

Eggen and Kauchak (2007) detailed another major tenet of Vygotsky's theory: the zone of proximal development. A person is in the zone for a specific task, if they are able to complete a task with assistance from a more knowledgeable peer or adult. If a person is unable to complete the task with assistance, they are below the zone. Conversely, if they can complete it without assistance, they are above the zone. The support provided by the peer or adult, to enable the learner to move through the zone of proximal development, is called scaffolding.

In comparing the views of learning of Piaget and Vygotsky, Eggen and Kauchak (2007) noted the major differences in their theories. Piaget emphasised each individual's construction of knowledge, while Vygotsky focused on the social transmission of language and culture, what he called the tools of knowledge. Piaget focused on disrupting equilibrium in order to promote learning, whereas Vygotsky emphasised the need for scaffolding to support learning. Piaget saw the learner as needing to actively manipulate objects and ideas in order to learn, whereas Vygotsky saw the learner as needing to be active in social contexts and interactions. According to Piaget, social interaction provided the means for validating and testing schemas. For Vygotsky, however, it provided the avenue for acquiring language and culture. Both Piaget and Vygotsky are constructivist in their orientation (Eggen & Kauchak, 2007) and have influenced the development of constructivism as a theory of learning and knowledge.

Constructivism

Richardson (2003) maintained that the general sense of constructivism is that of a theory of learning or meaning making; it "assumes that humans are sense-making beings, that they have a natural drive to make sense of their experience" (Simon, 1993b, p. 101). It "is a popular position...not only in mathematics education but in developmental psychology, theories of the family, human sexuality, psychology of gender and even computer technology" (Noddings, 1990, p. 7). Phillips (1995) focused on the wide diversity in constructivist thinking, citing authors from a broad theoretical and philosophical spectrum, including Kuhn, Piaget, Dewey, Popper and von Glasersfeld. According to Phillips they are all, in some sense, constructivist.

Despite the popularity of constructivism in many areas of study, agreement has not been reached on its definition (Ellerton & Clements, 1992; Phillips, 1995, 2000). However, it is agreed that there are many schools of thought within the constructivist framework (Clements & Ellerton, 1996; Matthews, 2000; Olsen, 1999; Richardson, 2003) and "as a construct and movement...[it has] become massively complex" (Richardson, 2003, p. 1624). The forms most often referred to in mathematics education literature are radical constructivism and social constructivism, with some writers claiming a place in the moderate constructivist camp (Ellerton & Clements, 1992; Goldin, 1990).

Goldin (1990), in detailing the influence of these different forms of constructivism on mathematics education, explained that theorists who embrace radical constructivism argue that "we can never have access to a world of reality, only to the world that we ourselves construct out of our own experience" (p. 35). "Knowledge is never *communicated*, but of epistemological necessity constructed (and reconstructed) by *unique individuals*" (p. 35). It is these two tenets then that define radical constructivism in terms of mathematics education: the individual's unique construction of knowledge and the assertion that there is no mathematical structure outside the individual's constructed knowledge. Radical constructivists look to Piaget as their pioneer, emphasising the individual's construction of knowledge, which derives from Piaget's developmental theory. Von Glasersfeld (1990) further maintained that this construction of knowledge is not arbitrary but, "constrained by social interaction and the need of collaboration and communication with other members of the group in which he or she grows up" (p. 26).

Radical constructivism has drawn strong criticism (Matthews, 2000) For example, Suchting (1992), criticised von Glasersfeld's doctrine of constructivism as "simply unintelligible" (p. 247), claiming that it has questionable philosophical and linguistic foundations. Ellerton and Clements (1992) maintained that to believe knowledge is actively constructed by a person and not passively received, does not infer that coming to know precludes the discovery of a pre-existing world outside the mind of the knower. They also questioned the radical constructivist notion that knowledge cannot be conveyed from one person to another by words and see this as a major weakness of constructivist theorising.

Social constructivism acknowledges both social processes and individual sense-making as having central and essential parts to play in the learning of mathematics (Ernest, 1994). Ernest (1994) delineated social constructivist views into two main branches, depending on whether Piagetian or Vygotskian theories of mind and learning are adopted as underlying assumptions. Social constructivism based on a Piagetian theory of mind, is radical constructivism plus social aspects of classroom interaction. This view argues that in the construction of knowledge, individual internal processes have a primary role with social interaction having a secondary, though important, function. It recognises both radical constructivism and interpersonal social interaction as two complementary, interacting, but disparate theoretical frameworks. Ernest (1994) suggested that social constructivism based on a Vygotskian theory of mind has greater merit, as it is a fully integrated perspective. "This approach views individual subjects and the realm of the social as indissolubly interconnected, with human subjects formed through their interaction with each other (as well as by their internal processes) in social contexts" (p. 69).

Moderate constructivism does not appear to be a branch of constructivism, but the position of those who reject one or more of the basic tenets of radical constructivism, while still maintaining that learning is a constructive process. The tenet most commonly rejected claims that mathematical structure does not exist apart from an individual's knowledge (Ellerton & Clements, 1992;

Goldin, 1990; Howe & Berv, 2000). In rejecting this claim, Ellerton and Clements (1992), citing the work of Del Campo and Clements, reported that many academics with social constructivist views admitted that they think Pythagoras' Theorem was true, even before the standard Pythagorean relationships were ever recognised by humans.

One does not need to be a radical constructivist to agree with most of its pedagogical claims (Goldin, 1990; Matthews, 2000). Matthews (2000) argued further, that one does not even need to be constructivist to embrace much of its recommendations for teaching. For example, Ellerton and Clements (1992) reported that in Japanese classrooms, where teachers had not been exposed to the constructivist movement, rich learning environments, where students were encouraged to create their own mathematics and take part in profitable social interactions, were the norm.

Davis (1997) maintained that constructivist principles might also refer to 'experiential learning' or 'discovery learning', or, as Smith (1996) noted, 'active learning'. While refusing to be drawn into the argument regarding these different names, Davis (1997) emphasised that they are alike, in that they represent a vision of mathematics education compared to the 'telling' or 'showing' approach. Nelson (2001) described teaching designed to support this kind of learning as 'facilitative teaching'.

Alternatives to experiential learning are not mutually exclusive, but options which can be used in combination (Davis, 1997). Goldin (1990) contended that "teachers should be able to characterize, implement and evaluate critically a range of approaches from those in which the teacher states and exemplifies rules, to those in which the student detects patterns in situations and formulates and verifies conjectures" (p. 45).

Koehler and Grouws (1992), in looking at research on teaching and learning, summarised and contrasted several different research paradigms. These included the constructivist approach evident in the Purdue Project[1] (Cobb, 1988; Cobb, Yackel, & Wood, 1988); Cognitively Guided Instruction (CGI)[2] (Carpenter & Fennema, 1988; Fennema, Carpenter, & Peterson, 1989); the expert-novice paradigm typified by Leinhardt (1989); the sociological and epistemological view of mathematics teaching and learning as proposed by Lampert (1988; 1989; 1990); and the mathematics content view as espoused by Hiebert and Wearne (1988a; 1988b). They found that, while these programs and paradigms held distinct and different views of teaching and learning, there were two basic points of agreement: "Students are not passive absorbers of information, but rather have an active part to play in the acquisition of knowledge and strategies" (Koehler & Grouws, 1992, p. 123), and that teachers should be informed and reflective decision makers.

The position, therefore, of this thesis is that effective mathematics pedagogy can include teaching from many perspectives, not just that of constructivism. Effective mathematics teaching practice will, however, be consistent with constructivism in its beliefs that students are active agents in the acquisition of knowledge, and that effective teaching practice is based on informed and reflective teacher decisions. Being informed by current research into mathematics education and quality teaching, this type of practice will be "reform-oriented" (Smith & Lowrie, 2001), seeking to develop students' conceptual understanding of mathematics, while improving their attitudes to mathematics and confidence in themselves as learners of mathematics. It is from this viewpoint that I shall review the literature on mathematics teaching and determine the implications for teaching mathematics effectively.

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[1] The Purdue Project is one of the most significant studies into establishing learning environments based on constructivist principles. The project began as a study of one 2nd Grade classroom, but due to its success this study was extended to include eighteen 2nd and 3rd Grade classes.

[2] Cognitively Guided Instruction was a teacher development program studying the changes in the beliefs and instruction of 21 teachers over 4 years.

Effective mathematics teaching

The development of the model of quality teaching in NSW

Identifying and defining aspects of quality teaching has always been difficult due to the complex nature of teaching and the “complexity of studying these phenomena” (NSW Department of Education and Training, 2003b, p. 4). The Schools Council in 1989 described ’quality’ as an elusive concept, “understood by most people at some intuitive level, but very difficult to define” (p. 1). However, recent developments in educational research have given "serious insights into the fundamental educational question of what makes effective pedagogy" (NSW Department of Education and Training, 2003b, p. 4). The term ‘pedagogy’ “recognises that how one teaches is inseparable from what one teaches, from what and how one assesses and from how one learns” (NSW Department of Education and Training, 2003e, p. 4). The current developments in research on pedagogy underpin the development of the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

The NSW model of pedagogy (NSW Department of Education and Training, 2003e) was introduced in 2003. It is a research-based model that has been developed largely from the work of Newmann and his colleagues using a model of Authentic Pedagogy (Newmann & Associates, 1996; Newmann, Bryk, & Nagaoka, 2001; Newmann, Lopez, & Bryk, 1998; Newmann, Marks, & Gamoran, 1995; Newmann, Marks et al., 1996; Smith, Lee, & Newmann, 2001) and the Queensland School Reform Longitudinal Study using the concept of productive pedagogies (Education Queensland, 2001).

The Authentic Pedagogy model came out of the School Restructuring Study which was sponsored by the US Department of Education in the early 1990s (Newmann & Associates, 1996). This model of pedagogy is consistent with a constructivist perspective of teaching and learning, where students are perceived as active learners. The model presents standards of intellectual quality, rather than teaching techniques or processes, as the essential objective of pedagogy (Newmann, Marks et al., 1996).

The Queensland School Reform Longitudinal Study (QSRLS) (Education Queensland, 2001) developed a research construct, using the work of Newmann and his colleagues, known as ‘productive pedagogies’ (NSW Department of Education and Training, 2003b). Researchers on the QSRLS considered it “necessary to unpack and re-contextualise” the notion of authentic pedagogy for the Australian context (Lingard, Hayes, & Mills, 2003, p. 409) adding an emphasis on social as well as academic outcomes. The productive pedagogy framework included additional dimensions to the standards of intellectual quality, than those specified in the work of Newmann and his colleagues (Lingard et al., 2003; NSW Department of Education and Training, 2003b).

While the work of Newmann and his colleagues (Newmann & Associates, 1996; Newmann et al., 2001; Newmann et al., 1998; Newmann et al., 1995; Newmann, Marks et al., 1996; Smith et al., 2001) and the QSRLS (Education Queensland, 2001) are not the only source of research from which the NSW model of pedagogy has been developed, they are foundational to the development of the ‘intellectual quality’ dimension of the model.

While the dimension of ‘intellectual quality’ is the linchpin of the NSW model of pedagogy, for students to benefit from being engaged in high ‘intellectual quality’ work the second and third dimensions, ‘quality learning environment’ and ‘significance’, are also essential (NSW Department of Education and Training, 2003e).

Developing a picture of quality teaching of mathematics

Recent developments in Australian education have resulted in the publication of *A National Framework for Professional Standards for Teaching (MCEETYA, 2003),* the establishment of the NSW Institute of Teachers

(NSW State Government, 2004) and the release of the NSW *Professional Teaching Standards* (NSW Institute of Teachers, 2005a). These initiatives have been motivated by a desire to guarantee the quality of teachers through a rigorous accreditation process, improve the status of teaching as a profession and ensure the quality of education for all students (MCEETYA, 2003; NSW Institute of Teachers, 2005a; NSW State Government, 2004).

Within mathematics education, the Australian Association of Mathematics Teachers (AAMT) published the *Standards for Excellence in Teaching Mathematics in Australian Schools* document (AAMT, 2002). This was adopted in 2002 by the AAMT Council "as representing a consensus view, by the profession for the profession, describing the knowledge, skills and attributes required for good teaching of mathematics" (AAMT, 2002). These *Standards* are structured using the same three domains of professional knowledge, professional attributes and professional practice used in the NSW *Professional Teaching Standards* published by the NSW Institute of Teaching (NSW Institute of Teachers, 2005a).

The AAMT *Standards* (AAMT, 2002) describe the specialised characteristics of the excellent teacher of mathematics. The NSW *Professional Teaching Standards* (NSW Institute of Teachers, 2005a) describe expectations of teachers, generally, within four stages of career development, from 'graduate teacher' through to the most accomplished level of 'professional leadership'. The NSW *Standards* specify seven elements of teaching within the three domains of professional knowledge, practice and commitment, giving descriptions of 46 aspects of these elements. The AAMT *Standards* describe ten elements in detail. While the elements described are not identical, the two documents have similarities in their descriptions of professional teaching standards.

The NSW model of pedagogy (NSW Department of Education and Training, 2003e) does not deal with the domains of 'professional knowledge' and 'professional commitment' but focuses attention on the domain of 'professional practice'. This is not undertaken for the purpose of the accreditation, or external evaluation of the quality of a teacher or her[3] teaching, but to provide a "framework for teachers' professional self-reflection" (p. 4) and to improve teaching practices. In line with this focus, the 18 elements of the model are described in terms of how they evidence themselves in the classroom, rather than as aspects or characteristics of teachers' skills and behaviours. They are generic in terms of their appropriateness to the full range of curriculum areas and grade levels from Kindergarten to Year 12. A more specific focus, in terms of how they are evidenced by effective teachers of mathematics, would be useful in developing a picture of quality mathematics teaching.

A framework of effective mathematics teaching practices

In looking to develop a framework of effective mathematics teaching, the work of D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999) provides a succinct summary of components of effective mathematics teaching they have identified in two projects. D. Clarke, in his doctoral research (cited in Clarke, 1997), identified seven projects or studies that evidenced teaching practices which harmonised with the vision of reform in mathematics education. Using these studies he summarised the key components of a teacher's role "in a reformed classroom" (p. 279) thus providing a conceptual framework in which to study the changing role of the mathematics teacher in a climate of reform. More recently, as part of the Early Numeracy Research Project (ENRP) in Victoria, B. and D. Clarke (2004) identified 25 common components, in 10 categories, of effective mathematics teaching[4] in K-2. While there are some differences, a comparative summary of these components shows clear similarities in the identified factors (See Table 1, p. 31).

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[3] When referring to school teachers generally feminine pronouns have been used to avoid using compounds such as 's/he' and improve the readability of the text.

[4] Effective mathematics teachers were identified over the period of the study by measuring the growth of their students' understanding across the school year.

Table 1 Summary of the components of effective and reform-oriented mathematics teaching

Summary of the components of reform-oriented (Clarke, 1997; Clarke, 1999) and effective mathematics teaching (Clarke & Clarke, 2004)		
Clarke 1997,1999	**Clarke & Clarke 2004**	**Component**
Identify and focus on the big ideas of mathematics	Mathematical focus • important ideas • make focus clear	• Content • Explicit focus
Non-routine problems as a starting point and focus	Features of tasks • enable different possibilities, strategies and products • engaging/motivating	• Problem solving • Motivation/engagement • Risk taking
Adaptation of materials and instruction for context/students' interests/needs	Materials, tools, representations • a range for the same concept	• Use of manipulatives
	Adaptations, connections, links • use teachable moments • links to previous lessons/experiences	• Building on prior knowledge • Integrated lessons
Variety of organisation styles (individual, small-group, whole-class)	Organisational style(s) and teaching approaches • introductory, whole-group activity • variety of individual, group and teacher roles	• Social organisation
Development of mathematics discourse community – teacher is fellow player who values and builds on students' solutions/methods	Learning community and classroom interaction • range of question types • refrain from telling everything • children explain thinking and ideas • children listen to and evaluate other children's ideas • listen to children • build on children's ideas and strategies	• Discussion
	Expectations • high but realistic for all children • promote/value effort, persistence, concentration	High Expectations
Facilitate student reflection on activity and learning	Reflection • draw out important ideas • teacher reflect on lesson etc	• Student reflection • Teacher reflection
Informal assessment to inform instruction	Assessment methods • collect data • variety of methods • modify planning as result	• Assessment
	Personal attributes • mathematics enjoyable • confident in mathematics knowledge • show pride and pleasure in students' success	• Teachers' beliefs and attitudes • Teachers' confidence in mathematics content and teaching • Teachers' relationship with students
Implicit in both of these lists of components of effective teaching:		• Teaching for conceptual understanding

The effective teachers of mathematics identified in the later study (Clarke & Clarke, 2004), were utilising the type of reform-oriented pedagogy identified in Clarke's earlier research (1997; 1999). In utilising reform-oriented teaching practices these teachers were demonstrably effective in supporting remarkable growth in their students' understanding. Clarke and Clarke (2004) surmised that, while this research focuses on effective teachers of K-2 mathematics, research focused on Grades 3-6 would yield similar results. While research with this particular focus has not yet been undertaken, the following review of mathematics education literature supports Clarke and Clarke's (2004) selection of the individual components of effective mathematics teaching across both the infants and primary grades.

The NSW model of pedagogy in terms of mathematics research literature

Having identified the components of effective mathematics teaching in the literature by D. and B. Clarke (Table 1, p. 31), an attempt has been made to align these components to the more generic dimensions and elements of the NSW model of pedagogy in a framework of quality mathematics teaching (see Table 2, p. 33). Most of the components of effective mathematics teaching identified in the research by B. and D. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999) have very clear connections with elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e), sometimes having links to more than one element. Other components of effective mathematics teaching, while being connected to the element identified in the model, are not the main focus of the element. These differences are highlighted in the table. Using the connections evident in Table 2 (p. 33) the structure of NSW Model of pedagogy will be used as a basis for the structuring of this review of the relevant mathematics education literature. This is not straightforward because many of the components of effective mathematics teaching could comfortably fit within more than one of the dimensions of the model. Where this occurs a decision of where it best fits has been made.

Table 2 Framework of quality mathematics teaching

<table>
<tr><td colspan="4">Framework of quality mathematics teaching: A comparison of the elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) with the components of effective teaching identified by D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999).</td></tr>
<tr><td colspan="2">NSW model of pedagogy, 2003</td><td rowspan="2">Components of effective teaching - Clarke studies</td><td rowspan="2">Components classified for the review of literature</td></tr>
<tr><td>Dimensions</td><td>Elements</td></tr>
<tr><td rowspan="6">1. Intellectual quality</td><td>1. Deep knowledge</td><td>• Content
• Explicit focus
• Use of resources*</td><td rowspan="6">► Content
► Explicit mathematical focus
► Teaching for conceptual understanding
► Problem solving
► Discussion
► Written work
► Student reflection</td></tr>
<tr><td>2. Deep understanding</td><td>• Conceptual understanding*</td></tr>
<tr><td>3. Problematic Knowledge</td><td>• Problem solving*
• Use of resources*</td></tr>
<tr><td>4. Higher-order thinking</td><td>• Conceptual understanding*
• Student reflection*</td></tr>
<tr><td>5. Metalanguage</td><td rowspan="2">• Discussion*
• Student reflection*
• Written work</td></tr>
<tr><td>6. Substantive communication</td></tr>
<tr><td rowspan="6">2. Quality learning environment</td><td>7. Explicit quality criteria</td><td></td><td rowspan="6">► Motivation/engagement
► Use of mathematical resources
► High expectations
► Risk taking
► Social organisation
► Teacher’s relationship with students
► [student autonomy] – strongly supported in mathematic literature but not in Clarke & Clarke components
► Student direction in problems solving and use of resources</td></tr>
<tr><td>8. Engagement</td><td>• Motivation/engagement
• Use of resources*</td></tr>
<tr><td>9. High expectations</td><td>• High expectations
• Risk taking*</td></tr>
<tr><td>10. Social support</td><td>• Discussion*
• Classroom organisation
• Teacher’s relationships*
• Risk taking*</td></tr>
<tr><td>11. Students’ self-regulation</td><td>• Risk taking*</td></tr>
<tr><td>12. Student direction</td><td>• Problem solving*
• Use of resources*</td></tr>
<tr><td rowspan="6">3. Significance</td><td>13. Background knowledge</td><td>• Building on prior knowledge</td><td rowspan="6">► Building on prior knowledge
► Integrated lessons</td></tr>
<tr><td>14. Cultural knowledge</td><td></td></tr>
<tr><td>15. Knowledge integration</td><td>• Integrated lessons</td></tr>
<tr><td>16. Inclusivity</td><td>• High expectations*</td></tr>
<tr><td>17. Connectedness</td><td>• Problem solving*</td></tr>
<tr><td>18. Narrative</td><td></td></tr>
<tr><td rowspan="3">Elements not specified in the 3 dimensions of the model</td><td>Personal attributes</td><td>• Teachers’ beliefs and attitudes
• Teachers’ confidence in mathematics content and teaching</td><td>► Teachers’ beliefs and attitudes
► Teachers’ confidence in mathematics content and teaching</td></tr>
<tr><td>The model is a framework for teachers’ reflection</td><td>• Teacher reflection</td><td>► Teacher reflection</td></tr>
<tr><td>Assessment is addressed in each of the 18 elements</td><td>• Assessment</td><td>► Assessment</td></tr>
<tr><td colspan="4">Key: Normal print = Clear connections Italicised = Some connection Marked with * = In more than one element</td></tr>
</table>

Therefore, while this is not an accurate representation of all the connections that can be made between the elements of the model and the components of effective mathematics teaching, it does provide a useful structure for organising the review of mathematics education literature (see Table 3, p. 34). The review of literature on the components is not exhaustive, as many have vast amounts of research pertinent to them. The aim of this review is to highlight the best use of a particular component to ensure the high quality teaching of mathematics, and to be aware of any potential difficulties associated with its use.

Table 3 Outline of the review of mathematics literature

The Outline of the Review of Mathematics Literature
Dimension 1: Intellectual quality
Element 1: Deep knowledge
► Content
► Explicit mathematical focus
Element 2: Deep understanding & Element 4: Higher-order thinking
► Teaching for conceptual understanding
Element 3: Problematic Knowledge
► Problem solving
Element 5: Metalanguage & Element 6: Substantive communication
► Discussion
► Written work
► Student reflection
Dimension 2: Quality learning environment
Element 8: Engagement
► Motivation
► Use of mathematical resources
Element 9: High expectations
► High expectations for all children
► Risk taking
Element 10: Social support
► Social organisation of the classroom
► Teacher's relationship with students
Element 11: Students' self-regulation
► Student autonomy
Element 12: Student direction
► Student direction in problem solving and use of resources

Dimension 3: Significance

Element 13: Background knowledge

- Building on prior knowledge

Element 15: Knowledge integration

- Integrated lessons (across strands and KLAs)

Elements not specified in the 3 dimensions of the model

- Teachers' beliefs and attitudes
- Teachers confidence in mathematics content and teaching
- Teacher reflection
- Assessment

Dimension 1: Intellectual quality

Pedagogy that focuses on the development of intellectual quality has been demonstrated to benefit the full range of students including high and low achievers, educationally disadvantaged, gifted and talented or those with special needs (Newmann et al., 1995; Newmann, Marks et al., 1996; NSW Department of Education and Training, 2003e). These benefits have been shown in both performance-based assessments and standardised achievement tests (Newmann et al., 2001; Newmann et al., 1995; NSW Department of Education and Training, 2003e).

Within the NSW model

> *Intellectual quality refers to pedagogy focused on producing deep understanding of important, substantive concepts, skills and ideas. Such pedagogy treats knowledge as something that requires active construction and requires students to engage in higher-order thinking and to communicate substantively about what they are learning* (NSW Department of Education and Training, 2003e, p. 9).

The 'Working Mathematically' strand of the Mathematics K-6: Syllabus 2002 (Board of Studies NSW, 2002) is integrated into the content of every other strand in the Syllabus, making it "central to the purpose for learning mathematics" (Anderson, 2005, p. 53) in NSW schools. In reviewing the NSW model of pedagogy (NSW Department of Education and Training, 2003e) Anderson (2005) aligned the elements of the model with the processes of 'working mathematically' and concluded that "there is a particular emphasis on the dimension of intellectual quality in the working mathematically processes" (Anderson, 2005, p. 56). Within this framework the mathematics education literature has been explored focusing on the components of content, explicit mathematical focus, developing conceptual understanding, problem solving, discussion, written work and student reflection.

Element 1: Deep knowledge

- "The knowledge being addressed is focused on a small number of key concepts and ideas within topics, subjects or KLAs, and on the relationships between and among concepts" (NSW Department of Education and Training, 2003e, p. 11).

Content

Teachers in reformed classrooms concentrate on 'big' mathematical ideas (Clarke, 1997, 1999; Gill & Thompson, 1995), seeking to develop within their students' important mathematical concepts rather than bits of mathematical knowledge. Philipp, Flores, Sowder and Schappelle (1994) identified four 'extraordinary' [5] teachers. Among other things, these teachers began their planning with the big ideas they wanted their students to learn and worked down to the individual lessons.

The *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002) has been written to accommodate this type of planning and focus. It details both essential and non-essential content in terms of the knowledge, skills and understanding that should be shown by a student at the end of the relevant Stage. It also provides a scope and continuum for K-10 which gives an

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[5] These teachers were 'extraordinary' in that they were recognised within their local mathematics community as exemplary teachers, often "selected to lead or assist in local and state-level projects such as curriculum and testing reform, research and leadership projects and professional development for other mathematics teachers" (Philipp et al., 1994, p. 157).

overview of key ideas, within the essential content of each strand, showing the development of these key ideas throughout the K-10 years.

Newmann, King and Secada (1996) described the type of content selected to promote the development of intellectual quality as ‘authentic’, content that has “value or meaning beyond success in school” (p. 164). They described the need for teachers to discuss the importance of specific content and its integration within and across disciplines. They also maintained the need for discussion among teachers on how to balance training in basic skills with educating for in-depth understanding.

Explicit mathematical focus

In focusing on the ‘big’ mathematical ideas, teachers have specific agendas for what is to be learned (Confrey, 1990). Richards (1991) emphasised that thorough teacher preparation is essential for the success of a ‘reformed’ classroom. Effective mathematics teachers structure activities that guide exploration of the key concepts they want their students to learn. Although students construct their own mathematical understanding, they will not discover the mathematical concepts by accident; “teachers must design tasks and projects that stimulate students to ask questions, pose problems and set goals” (p. 40). Children’s ‘discovery’ needs to be closely monitored by the teacher who should maintain contact with pupils’ thinking, in order to guide instruction and achieve more powerful results (Davis, 1997). Cobb, Wood and Yackel (1991) stressed that classrooms with a constructivist orientation are not ones where ‘anything goes’.

Making the mathematical focus clear to students is an important aspect of effective mathematics teaching (Clarke & Clarke, 2004). In all likelihood this will occur in a number of ways throughout a unit of work, including the introductory activities, using ‘teachable’ moments when they occur, making connections with previously learnt ideas, questioning, sharing students’ solutions, conducting reflective discussions (Clarke & Clarke, 2004), and the nature and focus of assessment tasks (Clarke & Clarke, 1999).

Element 2: Deep understanding and Element 4: Higher-order thinking

- “Students demonstrate a profound and meaningful understanding of central ideas and the relationships between and among those central ideas” (NSW Department of Education and Training, 2003e, p. 11).
- “Students are regularly engaged in thinking that requires them to organise, reorganise, apply, analyse, synthesise and evaluate knowledge and information” (NSW Department of Education and Training, 2003e, p. 11).

Teaching for conceptual understanding

Within the context of improving the quality of learning mathematics this component is arguably the most important factor of quality teaching. Anderson (2005) maintained that:

> *Quality learning involves having a deep understanding of mathematical ideas and being able to use this flexibly and creatively. Quality teaching requires teachers to provide opportunities for students to be able to develop deep understanding, flexibility and creativity in using mathematical ideas* (p. 58).

However, teaching for a ‘deep’ understanding of mathematics requires an approach quite different from the ways mathematics has been taught traditionally.

Transmission/traditional model of teaching mathematics

The “transmission of knowledge” model of learning is the traditional model in Western society (Cobb, 1988, p. 87). In mathematics education it refers to a view of mathematics as a “a static discipline which is taught and learned through the transmission of mathematical skills and knowledge from the teacher to the learner” (Perry, Howard, Southwell, & Tracey, 1999, p. 64). It relies heavily on ‘telling’ as its main instructional method (Smith III, 1996), and is focused on skill acquisition (Jones, 1997) rather than conceptual understanding. It has been the predominant method of teaching mathematics and usually involves a demonstration or explanation of what to do and the provision of multiple examples for practice (Meserve & Suydam cited in Wood & Turner-Vorbeck, 2001).

In providing the historical background for the development of the National Council of Teachers of Mathematics *Standards* (NCTM, 1989), Schoenfeld (2004) maintained that the failure of traditional mathematics teaching to adequately equip students mathematically, coupled with “new ways of understanding knowledge, thinking and learning” (p. 262) necessitated a shift in goals for mathematics education. “Students needed to learn to think mathematically as well as to master the relevant mathematical content" (p. 263). Clements and Battista (1990) argued that taking a constructivist perspective in teaching mathematics implies that students should develop more complex, abstract and powerful mathematics structures.

Developing a conceptual understanding of mathematics

Skemp (1976; 1978) maintained that there are two different types of mathematical understanding which are the result of “two effectively different subjects being taught under the same name ‘mathematics’” (Skemp, 1978, p. 11). Instrumental understanding is knowing a rule and being able to use it. Relational understanding is knowing what to do and why. From an instrumental perspective, mathematical understanding is the knowledge of a fixed plan for performing a mathematical task. Relational understanding is characterised by a grasp of a concept, such that the person is able to determine several ways of performing a task.

Hiebert and Carpenter (1992) contended that this type of understanding involves making connections between facts, procedures and ideas, and building on students’ prior knowledge and experiences. It is generative rather than received; it promotes remembering; it reduces the amount of information that needs to be remembered; and it enhances the ability to transfer knowledge to new situations in order to solve new problems. In contrast, “When students do not understand, they perceive each topic as an isolated skill, and they cannot apply their skills to solve problems not explicitly covered by instruction, nor extend their learning to new topics" (Carpenter, Ansell, & Levi, 2001, p. 27). Being able to solve problems in new contexts or problems that differ from those with which one has experience is "the mark of powerful learning" (Schoenfeld, 2004, p. 262).

To foster this type of understanding in their students, von Glasersfeld (1994) suggested that teachers need to focus their attention on their students' mental operations, rather than to their performance or to rote learning. In understanding the sense students are making of a mathematical problem, teachers can address students' difficulties or build on students' solutions and methods (Clarke, 1997). Philipp et al. (1994) found that this type of pedagogy typified the practice of teachers identified as 'extraordinary'.

Within the context of developing a conceptual rather than procedural understanding of mathematics, a shift in emphasis from teaching conventional algorithms to mental computation, using a variety of strategies and number sense, has been advocated by researchers world wide (Hartnett, 2005). Hartnett (2005) claimed that this is reflected in syllabus documents across Australia, but in terms of the NSW K-6 Mathematics Syllabus (Board of Studies NSW, 2002) Chick and Baker's (2005) summation, that most curriculum documents place an emphasis on both, would be more accurate.

Within this context it is important to be aware that teaching conventional algorithms too early risks students losing conceptual knowledge while gaining procedural knowledge, losing faith in their own understanding of numbers and the use of flexible strategies and relying instead on a single procedure without thought (Clarke, 2005). Pushing students algorithmically beyond their conceptual understanding can lead to rote memorisation and prevent them from gaining a deep understanding of the mathematics (Chatterley & Peck, 1995).

Element 3: Problematic knowledge

- "Students are encouraged to address multiple perspectives and/or solutions and to recognise that knowledge has been constructed and therefore is open to question" (NSW Department of Education and Training, 2003e, p. 11).

Problem solving

In a sense, all mathematics can be seen as problem solving regardless of whether traditional or reform-oriented practices are utilised in its teaching. It is necessary then, to distinguish problem solving as an approach to mathematics teaching, as opposed to a mastery learning regime (Clements & Ellerton, 1996). A mastery learning regime is where procedures are demonstrated and students copy and practise these procedures on multiple example problems, until they have mastered the procedures. A problem solving approach to teaching involves the teacher providing rich mathematical tasks, where students are challenged to investigate and solve problems in various ways and develop their own understandings and procedures. "Students should experience the reward of arriving at solutions through their own initiative and persistence and not simply through imitation" (Australian Education Council, 1991, p. 21). Approached in this way, problem solving is not a topic in the mathematics curriculum but an "umbrella under which all other mathematical concepts and skills can be learned" (Capraro, 2001, p. 9).

The importance of problem solving is recognised in the *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002) as a key mathematical competency. This document encourages teachers to provide "meaningful and challenging problems" (p. 12) in a variety of contexts, within mathematics and across other KLAs. It promotes the teaching of mathematics through problem solving, highlighting the benefits this type of approach can produce in improving student attitudes towards mathematics, as well as giving students an awareness of the significance of mathematics to society. "Problem solving can promote communication, critical reflection, creativity, analysis, organisation, experimentation, synthesis, generalisation, validation, perseverance, and systematic recording of information” (p. 12).

Moreover, Philipp et al. (1994) found that ‘extraordinary’ teachers adamantly believed mathematics in schools should not focus on algorithmic skill learning, but should have a strong emphasis on problem solving. Based on Clarke’s (1997; 1999) summation of the role of teachers in a ‘reformed’ mathematics classroom, these teachers provide non-routine problems as a focus for learning, where no procedures for a solution are provided. They also adapt problems to their local context, as well as to the children’s needs and knowledge. This is consistent with *A National Statement on Mathematics for Australian Schools* (Australian Education Council, 1991) which states “students should gain considerable experience in dealing with non-routine mathematical problems and unfamiliar situations” (p. 12). Cobb, Wood and Yackel (1991) argued that from a constructivist view, “substantive mathematical learning is a problem solving process” (p. 158). They describe a classroom based on constructivist theory as a problem solving classroom.

The quality of the mathematical tasks provided by a teacher is an important factor in supporting the development of powerful mathematical understanding. A “good mathematics curriculum starts with rich mathematical tasks” (Williams cited in Skoss, 2005, p. 375). Booker (1999) argued that these tasks need to be ‘authentic’, and the focus needs to be on a variety of solution paths, rather than one right answer, requiring ‘thinking and understanding, rather than the memorisation of facts, procedures, and techniques." (p. 2). Catholic Education South Australia (2004) found, in its investigation of building mathematical understanding through a constructivist approach to teaching, that the selection of investigative and open-ended tasks was important in supporting students to work mathematically and develop mathematical understanding. These types of tasks enabled students to begin at their own level and allowed them to build on their prior knowledge and experiences. Whitin (2004) encouraged teachers to use children’s observations as a starting point for investigations and to involve students, as problems solvers, in posing their own problems; "By posing their own problems, children gain confidence in setting their own mathematical challenges as well as demonstrating mathematical competencies" (Whitin, 2004, pp. 131-132). Booker (1999) also supported the involvement of students in setting their own problems, arguing that this approach "necessitates an understanding of a problem's structure" (p. 4).

Cobb, Wood and Yackel (1991) asserted that the problems which promote worthwhile mathematical learning are not textbook word problems, but rather instructional activities that give rise to problematic situations. These problematic situations arise from students' social interactions and their solo attempts to deal with these situations. They claimed that substantive learning occurs in periods of conflict, confusion and surprise (Cobb, Wood, & Yackel, 1990). This concept can be seen to derive from Piaget's theories of learning and the notion of equilibrium. Steffe and Tzur (1994) described this in their learning model, where mathematical activity and learning are seen to be driven by perturbation. In seeking paths to neutralise perturbation and restore equilibrium, children make adaptations in their thinking (Steffe, 1988). In the Purdue Project (Wood, 1993b) the classroom was organised using social interaction to create cognitive conflict. This approach to teaching is advocated in *A National Statement on Mathematics for Australian Schools* (Australian Education Council, 1991). However, teachers find it difficult to allow students to struggle with problems, often providing help too quickly (Hiebert & Wearne, 2003) by supplying strategies, procedures and short cuts (Chatterley & Peck, 1995).

Element 5: Metalanguage and Element 6: Substantive communication

- "Lessons explicitly name and analyse knowledge as a specialist language (metalanguage), and provide frequent commentary on language use and the various contexts of differing language uses" (NSW Department of Education and Training, 2003e, p. 11).
- "Students are regularly engaged in sustained conversations about the concepts and ideas they are encountering. These conversations can be

The ‘Working Mathematically’ strand of the *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002) includes the five processes of Questioning, Applying Strategies, Communicating, Reasoning and Reflecting, which are integrated into the content of every other strand of the Syllabus. These processes are particularly relevant to the three components in this section (discussion, written work and student reflection). This is evident in the outcomes for ‘Working Mathematically’ where:

- the appropriate use of mathematical language is detailed within the Communicating outcomes;
- the terms ‘ask’, ‘describe’, ‘represent’, ‘explain’, ‘demonstrate’ and ‘support’ are used to detail the outcomes across all Stages;
- ‘Reflecting’ is included as a one of the ‘Working Mathematically’ processes;
- all of the five processes can all be evidenced using oral, written and artistic means (p. 19).

Discussion

The Cockcroft Report (1982) identified the importance of students communicating about mathematics, stating: “Language plays an essential part in the formulation and expression of mathematical ideas” (p. 89). Requiring more than teacher dominated question and answer sessions, students need to be engaged in discussions and explanations that give them opportunities to develop and refine their use of mathematical language as well as reflect upon and develop their mathematical ideas.

Language and social interaction are considered vital to learning (Eggen & Kauchak, 2007) and intellectual development evolves from the social to the individual (Confrey, 1995). In this context, discussion is seen as a “critical tool in the construction of knowledge, not simply an articulation of what is assumed to be already ‘inside’ the learner's head" (Hicks, 1998, p. 241). In the tradition of a sociocultural theory of mind, based largely on the work of

Vygotsky, thought can be understood as an internal conversation based in prior social interaction (O'Connor, 1998). In mathematics education as in all education, whether formal or informal, learning, language and social interaction are inextricably linked.

Clarke (1997) described the establishment of discussion within a ‘reformed’ classroom as building a “mathematics discourse community” (p. 291), a classroom where students are not only doing mathematics or talking about mathematics, they are also talking about doing mathematics. This type of mathematical discourse establishes explanation and justification as part of doing mathematics in the classroom (Simon, 1993b). In their study of ‘extraordinary’ teachers’ classroom practices, Philipp et al. (1994) found that these teachers had well established routines where students knew they would be required to demonstrate, explain and justify their answers.

Brousseau (1984) highlighted the important role of mutual expectations between teachers and pupils in the construction of mathematics learning environments, describing these expectations as constituting a didactical contract. In establishing a mathematics discourse community the established didactical contract in a classroom may need to be renegotiated. This type of classroom community, where mathematical discourse is an established routine, takes time to develop and needs to be monitored and maintained (Johanning & Keusch, 2004). To create the social norms necessary to the establishment of a ‘mathematics discourse community’, it is essential that the teacher protect the children’s right to express their understandings without fear of social comparison or public embarrassment (Cobb et al., 1991; Johanning & Keusch, 2004; Richards, 1991; Steele, 1999/2000). The teacher does this by directing rules and classroom expectations, thereby creating a psychologically safe environment (Johanning & Keusch, 2004; Steele, 1999/2000; Wood, 1993a). In the Purdue Project Cobb, Wood and Yackel (1991) found that this type of approach led to even the most conceptually immature student feeling his views were valued and respected, and consequently he continued to participate in discussions throughout the year.

The encouragement of this type of risk taking environment requires teachers to remove the “stark evaluative climate” that can exist in classrooms (Confrey, 1994, p. 5). In the Purdue Project discussions were not funnelled (Cobb et al., 1991) towards officially sanctioned interpretations and solutions. In fact, the teacher actively taught the students that this was not an expectation, by establishing clear obligations for classroom discussions. These expectations required that the students honestly express their understandings and that the teacher refrain from evaluating pupil answers against an official solution (Cobb et al., 1991). As Speiser and Walter (1996) pointed out, it is not the teacher’s role to tell children how to think, but to recognise that people understand differently. Instead of a quick ‘right’ or ‘wrong’ response, teachers need to recognise that diversity among individuals is a fundamental part of learning (Confrey, 1994). This type of teaching places correctness, precision, prompt recall and speedy task completion as secondary to the individual’s process of making sense of the mathematics (Bauersfeld, 1992; Booker, 1999). In a classroom where the teacher seeks to support children’s mathematical thinking, mistakes become opportunities for further investigation rather than marks of failure. Japanese teachers successfully use student errors as a basis on which to build discussion (Stigler & Baranes cited in Clements & Ellerton, 1996).

The establishment of this type of classroom discourse can involve major changes for both students and teachers (Cobb, Yackel, & Wood, 1993; Richards, 1991; Wood & Turner-Vorbeck, 2001). Richards (1991) pointed out that both teachers and students need to learn how to carry on mathematical discussions. To support discussion in the classroom, Richards argued that “there has to be a consensual domain that supports significant participation on the part of students” (p. 37). This consensual domain can only be established by both the teacher and students cooperatively contributing to the social organisation of the classroom (Mehan cited in Richards, 1991). In the Purdue Project, Cobb, Yackel and Wood (1993) found children originally responded to the opportunity to express their views by trying to infer the teacher’s desired response rather than their own. To establish different classroom norms the teacher introduced two levels of conversation: talking about mathematics; and talking about talking about mathematics. In this way, the teacher initiated and guided the renegotiation of classroom social norms in regard to the children's roles, the teacher's role and the nature of mathematics. Wood and Turner-Vorbeck (2001) found that the type of teaching which supports children being actively involved in this type of interaction and discourse is far more complex than pedagogy involved in traditional teaching. This type of learning involves a community collaborating and negotiating meaning (Wood & Turner-Vorbeck, 2001).

Written work

The type of written work that is a common feature of a traditional mathematics lesson, where practice of repeated examples is the norm (Clements & Ellerton, 1996), is not the type of written work that would constitute 'substantive communication' within the NSW model of pedagogy (NSW Department of Education and Training, 2003e). 'Substantive communication', in this context, is writing about the ideas and concepts being encountered in mathematics lessons. Writing helps students clarify their thinking, make connections and understand new concepts (Waters & Montgomery, 1993). Booker (1999) argued that communication in mathematics teaching will assist students "to realise that mathematics is itself a language and one that is increasingly needed in a world shaped by information technology" (p. 4). In this context reading and writing about mathematics is essential to the development of mathematical literacy.

A 'mathematics discourse community', is supported by written as well as oral communication (Philipp et al., 1994). This type of communication assists students in clarifying their ideas as well as enabling teachers to gain insights into students' thinking (Booker, 1999; Southwell, 1993; Waters & Montgomery, 1993), being useful for student assessment (Southwell, 1993; Waters & Montgomery, 1993). Writing can be used to record or explain procedures, student thinking or solution attempts, it can also be used to support explorations and investigations in mathematics (Southwell, 1993; Waters & Montgomery, 1993). It can be used to scaffold student learning, by mirroring children's thinking and faithfully recording it, rather than portraying common algorithms which are unconnected to children's strategies (Gill & Thompson, 1995). Philipp et al. (1994) reported that 'extraordinary' teachers value writing in their mathematics lessons. They encourage children to keep mathematics journals and set written assignments where children can show how they are solving a problem by writing and drawing.

Booker (1999) argued that mathematics is a language, and in acquiring this language there is a large body of metalanguage (specialist language), including the use of symbols and notation, to learn. "The symbolic nature of mathematics provides a powerful, precise and concise means of communication" (Board of Studies NSW, 2002, p. 7). The *Mathematics K-6 Syllabus* (Board of Studies NSW, 2002) gives advice about language and literacy within its content pages, as well as recommended terminology within its teaching and learning units (Board of Studies NSW, 2003), to assist teachers to scaffold students in their acquisition of mathematical metalanguage.

Student Reflection

The *Mathematics K-6 Syllabus* (Board of Studies NSW, 2002) includes student reflection as one of the processes of the 'Working Mathematically' strand to be integrated across all other strands. As an overarching outcome, students are to "reflect on their experiences and critical understanding to make connections with, and generalisations about, existing knowledge and understanding" in relation to the Stage content applicable to them (Board of Studies NSW, 2002, p. 19).

In likening the concept of reflection to the characteristics of reflection used in mathematics, Southwell (1999) said "the original experience is reproduced in another situation or position but the essential characteristics of the experience are retained. The person concerned is simply looking at the experience from another position" (p. 54). Reflection involves re-evaluating and making sense of experiences, gaining new perspectives and building on prior mathematical knowledge. It is a "powerful means" of increasing students' knowledge of mathematics especially when used in problem solving, problem posing and investigations (p. 160).

Bruner (cited in Catholic Education South Australia, 2004) believed that the capacity for reflective thought originates in social interactions and that learning with understanding necessitates the construction of knowledge through reflection. Von Glasersfeld (1991) maintained that reflection is a vital source of knowledge, therefore, to ensure that they reflect "students should be led to talk about their thoughts, to each other, to the teacher, or to both. To verbalise what one is doing ensures that one is examining it" (p. xviii). He also argued that enabling students to discuss their views of a problem and their own tentative approaches to its solution, builds self confidence. Discussion allows students to reflect on their own and others' ideas and provides the opportunity to devise new and perhaps more viable strategies (Australian Education Council, 1991; von Glasersfeld, 1991). Carpenter et al. (2001) found that when students articulated their strategies for solving a problem it often became a "form of public reflection" (Carpenter et al., 2001, p. 44).

Carpenter et al. (2001), in their study of two first-grade mathematics classes, found that reflection was vitally important in the development of students' mathematical thinking. Children developed more mature symbolic procedures, more advanced strategies and became more articulate in explaining their thinking. It was the classroom norm that children share their solution strategies and this became a key motivator for student reflection. "Students not only shared their answers; they made their thinking involved in solving the problem visible" (p.44).

Discussion which supports students' reflection on mathematical activity is part of the regular routine in 'reformed' classrooms (Clarke, 1997, 1999) and common in the classrooms of effective teachers of K-2 mathematics (Clarke & Clarke, 2004).

Dimension 2: Quality learning environment

The NSW model of pedagogy (NSW Department of Education and Training, 2003e) connects the quality of a learning environment with the quality of students' learning. Chapin and Eastman (1996) argued that creating a positive learning environment requires more than a focus on the external characteristics of the classroom. These facilitate, but do not create, the learning environment. "The internal characteristics of teachers have the greatest potential to transform the classroom into a learning environment that enhances the mathematical abilities of all students" (p. 114). This type of setting is characterised by care, safety and support, not only for students' emotional needs, but more specifically focused on their learning needs (NSW Department of Education and Training, 2003e).

Within the NSW model

> *Quality learning environment refers to pedagogy that creates classrooms where students and teachers work productively in an environment clearly focused on learning. Such pedagogy sets high and explicit expectations and develops positive relationships between teachers and students and among students* (NSW Department of Education and Training, 2003e, p. 9).

In aligning the NSW model of pedagogy (NSW Department of Education and Training, 2003e) with the components of effective teaching as identified in the work of B. and D. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999) the components of high expectations, risk taking, motivation/engagement, classroom organisation, the teacher's relationship with students, student autonomy and student direction were identified (Table 2, p. 33). This section will give an overview of the important aspects of these components, in an effective mathematics education environment, from the mathematics education literature.

Element 8: Engagement

- “Most students, most of the time, are seriously engaged in the lesson or assessment activity, rather than going through the motions. Students display sustained interest and attention” (NSW Department of Education and Training, 2003e, p. 13).

Motivation

Within the classroom setting, motivation refers to the forces that encourage a student to engage in an activity or pursue a goal, working persistently until a satisfactory result is achieved (Wolters & Rosenthal, 2000). Research on motivation identifies intrinsic and extrinsic sources of motivation and their roles in student learning (Marcou & Philippou, 2005; Middleton & Spanias, 1999; Stipek et al., 1998).

Marcou and Philippou (2005) outlined three kinds of motivational beliefs that influence students in their efforts to solve mathematical problems:

- Self-efficacy beliefs – beliefs about one's ability to complete a task successfully;
- Task related beliefs – beliefs about whether a task is valuable because it is important, of interest or of use; and
- Goal orientation
    - intrinsic goals such as meeting a challenge, curiosity or mastery;
    - extrinsic goals such as grades, rewards/punishments or competition.

They noted that self-efficacy beliefs are powerful indicators in predicting the successful completion of a task. The also noted that while intrinsic goals relate positively to performance, extrinsic goals relate negatively to performance.

In their review of the literature, Middleton and Spanias (1999) found that students’ motivations towards mathematics are greatly influenced by teacher behaviours and attitudes, they develop early, remain stable over time and are accurate predictors of the future mathematics involvement of students in senior high school and tertiary education. These motivations influence children's views of themselves as mathematics students and affect their self-concepts. Furthermore, students engaged in tasks in which they are intrinsically motivated spend more time on task, show persistence, evidence more detailed processing, select more difficult tasks, are more creative and are more willing to take risks in their learning.

This research highlights the importance of motivation in mathematics education, both in the long term effects on student performance and choice, as well as the short term benefits of engagement in mathematics lessons. In order to develop and maintain student motivation, it is necessary to establish notions of success in mathematics as being related to learning and developing understanding (Middleton & Spanias, 1999; Stipek et al., 1998) rather than correct answers, speedy computation and the successful following of procedures (Middleton & Spanias, 1999). Stipek et al. (1998) maintain that when success in mathematics is defined competitively, for some students, failure is guaranteed. They argued that engaging students in tasks that foster positive self-efficacy beliefs involves providing mathematical activities that vary in format, are moderately difficult, meaningful and relevant to the students.

Use of mathematical resources

Research indicates that the use of manipulative materials is beneficial in the learning and teaching of mathematics, particularly in the early childhood and primary years (Catholic Education South Australia, 2004; Clements, 1999; Perry et al., 1999). The NSW Board of Studies has reflected this across all Stages in the *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002) and the *Mathematics K-6: Sample units of work* (Board of Studies NSW, 2003).

The use of manipulative materials can "provide a point of focus which is neither the teacher nor the textbook", allowing students to manipulate, not only the materials, but their own ideas (Perry et al., 1999, p. 67). While the use of manipulatives is usually evidenced in teachers’ efforts to ‘reform’ their mathematics teaching, their use can be superficial (Knapp & Peterson, 1995; Smith III, 1996) and not sufficient to ensure meaningful learning (Clements, 1999).

Perry et al. (1999) found that teachers who espoused beliefs associated with the view that learning is ‘child centred’ reported a more frequent use of manipulative materials than teachers who held beliefs allied to the notion that learning is the result of ‘transmission’. This research did not investigate whether the more frequent use of manipulates occurred within the broader context of what the researchers described as ‘constructivist teaching’.

Another study (Forrester, 2000), into the beliefs and practices of primary school teachers in mathematics, found that teachers most commonly associated the success of a mathematics lesson with being ‘hands-on’. In a factor analysis of the teacher-reported use of thirteen variables associated with ‘reformed’ or ‘traditional’ models of mathematics teaching, three factors were extracted. While two of the three factors were very clear representations of these two models of teaching, a third represented the very common use of manipulative materials, independent of the use of other strategies associated with ‘reformed’ or ‘traditional’ teaching. This study found that manipulatives were more often used to give visual or tactile models for explanation or demonstration, than to scaffold efforts to solve problems.

Much of the research on the use of manipulative materials cautions against the assumption that their use ensures that children will learn the intended mathematics (Marshall & Swan, 2005; Perry et al., 1999). Clements (1999) argued that these types of materials need to be used in purposeful activities which are designed to build on children’s existing knowledge, with clear teacher guidance. When manipulative materials are used within these parameters students’ retain more knowledge, achieve greater scores in assessment activities and have more positive attitudes towards mathematics (Sowell, 1989).

Element 9: High expectations

- "High expectations of all students are communicated and conceptual risk taking is encouraged and rewarded" (NSW Department of Education and Training, 2003e, p. 13).

High expectations for all children

From Rosenthal and Jacobson's (1968) classical study, which identified teacher expectations as influential on student achievement, many studies have shown that teachers have differential expectations of individuals and that this affects student learning (Cooper & Tom, 1984; Good, 1970; Rubie-Davies, 2006), though the extent of this is not universally agreed upon (Jussim & Harber, 2005; Rubie-Davies, 2006). Rubie-Davies (2006) found that particular teachers have differential expectations of whole classes of children and that this also affects student learning. She concluded that it is essential that teachers be aware of the importance of having positive and high expectations for students, to ensure that students "remain optimistic, motivated, and successful within the school environment. In this way, every child will have the opportunity to thrive and reach his or her potential in a classroom environment that is supportive, constructive, encouraging, and caring" (p. 550).

The NSW model of pedagogy (NSW Department of Education and Training, 2003b) reflects the view that having high expectations for student learning is of unquestioned value. It acknowledges the difficulties for teachers in balancing the complexities of not conveying low expectations of some students, not communicating high expectations in an inflexible manner and continually using professional judgment in setting and explaining those expectations.

Within the mathematics teaching literature this is also evident, with encouragement for teachers to establish and explicate high expectations of classroom behaviour which support the learning of all students in a safe environment (Cobb et al., 1991; Fraivillig, Murphy, & Fuson, 1999; Johanning & Keusch, 2004; Liedtke, 1998; Richards, 1991; Steele, Winter, 1999/2000) and to have high but realistic mathematical expectations for all children (AAMT, 2002; Clarke & Clarke, 2004).

Risk taking

Risk taking within the context of learning is considered pedagogically desirable (Middleton & Spanias, 1999; NSW Department of Education and Training, 2003e). Classrooms, particularly in mathematics lessons, can be stark and evaluative, with quick ‘right’ and ‘wrong’ responses from teachers (Confrey, 1994, p. 5) and associated judgements from students (Stipek et al., 1998). The risks include failing in a task and/or revealing ignorance or failure to class members (Stipek et al., 1998). These types of experiences usually entail negative emotions and can discourage students from attempting tasks, sharing their attempts and/or opinions with others and asking for assistance (Stipek et al., 1998). Risk taking, in learning, involves being willing to explore, be involved in solving problems, seek help, ask questions and contribute to discussions (Fraivillig et al., 1999; Liedtke, 1998; Stipek et al., 1998).

Liedtke (1998) argued that being willing “to take risks requires a high level of confidence" (p. 64). While there is research that aligns risk taking behaviours to certain groups or personalities (Atkins, Leder, O'Halloran, Pollard, & Taylor, 1991; Meyer & Turner, 2006), in the context of making a high quality education available to all students, it is necessary to ensure that all students feel confident that their learning community will encourage them in their risk taking. This can only be achieved by ensuring that the “stark evaluative climate” (Confrey, 1994, p. 5) sometimes experienced in mathematics lessons, is replaced by a positive affective climate where students feel safe and supported (Stipek et al., 1998). This type of environment is fostered by focusing on student learning rather than ‘right answers’ (Stipek et al., 1998) and on teamwork rather than competition (Fraivillig et al., 1999). It requires clear guidelines for both student and teacher behaviours, where students know their contributions are valued and respected (Fraivillig et al., 1999;

Groves & Doig, 2004; Stipek et al., 1998). In this type of environment risk taking is simultaneously supported and minimised (Groves & Doig, 2004).

Element 10: Social Support

- "There is strong positive support for learning and mutual respect among teachers and students and others assisting students' learning. The classroom is free of negative personal comment or put-downs" (NSW Department of Education and Training, 2003e, p. 13).

Social organisation of the classroom

Mathematical understanding can be promoted by the teacher's use of a variety of organisational approaches, including whole class, individual and small group work (Clarke & Clarke, 2004; Clarke, 1997, 1999). Clarke and Clarke (2004) found that effective teachers of K-2 mathematics generally introduced a topic using a whole group activity to engage and focus the children's attention. These teachers went on to use a variety of groupings and individual structures in the major part of their lesson, drawing out the important ideas during and toward the end of the lesson.

The *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002) identifies "working with others and in teams" (p. 12) as a key competency, stating that this can facilitate learning. "Groupwork provides the opportunity for students to communicate mathematically with each other, to make conjectures, to cooperate and to persevere when solving problems and undertaking investigations" (p. 12).

We have seen that social interaction is fundamental to children's development and learning (Eggen & Kauchak, 2007; Wood & Turner-Vorbeck, 2001). Similarly, quality mathematical learning is facilitated by high quality social interactions (Ellerton & Clements, 1992) where pupils share their knowledge and make their knowledge shareable, by negotiating meaning within a group (Smith, 1996). Small groups are ideal for conducting investigations, sharing conjectures and validating ideas (Johanning &

Keusch, 2004). They give students more opportunities to verbalise their understandings, increase their responsibility for their own learning, build their social skills and increase their opportunities for experiencing multiple solution paths or seeing problems from different perspectives (Lindquist cited in Blunk, 1998).

Teachers' relationship with students

Many of the components of effective teaching that have been detailed to this point are substantially dependent on the quality of teachers' relationships with their students. Researchers have found students of teachers who respect and value them evidence increased motivation and achievement, social and academic growth (Manouchehri, 2004). In a positive affective climate, students are more willing to seek help, are more focused on mastering a concept and have more positive attitudes to the subject (Stipek et al., 1998). Students who feel a sense of 'relatedness' to their teachers demonstrate greater levels of behavioural, emotional and cognitive engagement in classroom activities (Stipek et al., 1998).

Element 11: Students' self-regulation

- "Students demonstrate autonomy and initiative so that minimal attention to the disciplining and regulation of student behaviour is required" (NSW Department of Education and Training, 2003e, p. 13).

Student autonomy

In the components of effective teaching identified by D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999) there was not specific mention of the development and support for students' autonomy in their mathematics learning. However, much of the mathematics education literature refers to this as a desirable outcome of effective teaching and students' self-regulation is identified as an element of quality teaching in the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

Student autonomy is often included as one of the many benefits of establishing a teaching and learning environment that supports students in constructing their own procedures for solving problems (Carpenter et al., 2001; Desforges & Cockburn, 1987; Manouchehri, 2004; Stipek et al., 1998; Whitin, 2004). However, it is more than a 'side effect' of effective teaching. Clements and Battista (1990) described two major goals of a constructivist approach to mathematics education: students should develop more complex, abstract and powerful mathematical understandings that enable them to solve a wide variety of meaningful problems; and they should become more autonomous and self-motivated in their mathematical activity. For students to transfer their learning into real-life contexts they need a "degree of intellectual autonomy" which enables them to "go beyond routine calculations" (Desforges & Cockburn, 1987, p. 3). The instructional practices already outlined in this chapter are those which foster student autonomy.

Element 12: Student direction

- "Students exercise some direction over the selection of activities related to their learning and the means and manner by which these activities will be done" (NSW Department of Education and Training, 2003e, p. 13).

Student direction in problem solving and use of resources

Smith, Lee and Newmann (2001), in their investigation of the links between instruction based in constructivist principles and academic achievement, found clear evidence that what they termed 'interactive' approaches were associated with improved academic performance. These approaches included the element of 'student direction', where teachers established classroom practices that accommodated student choices in topics and learning activities.

A problem solving approach to teaching mathematics provides many opportunities for students to take a role in determining aspects of their learning. Catholic Education South Australia (2004) found that learning environments, where students were able to investigate open-ended tasks, allowed children to build on their current understandings and enter the tasks at their own level. Having the opportunity to make decisions about how they would approach tasks, including what manipulative materials they might use in their investigations, saw students develop skills in discerning the appropriateness of methods and materials, and being able to justify their choices.

Whitin (2004) encouraged teachers to utilise problems posed by students as platforms for mathematical investigations or for extending current investigations. He maintained that using student observations as seeds for further problem posing, builds confidence in students' views of themselves as being able to make sense of mathematics. "It is a strategy that builds a spirit of intellectual excitement and adventure by legitimizing asking questions and freeing learners from the one-answer syndrome" (p. 129).

Dimension 3: Significance

The NSW model of pedagogy (NSW Department of Education and Training, 2003e) emphasises the need for all students to "see why, and to understand that, their learning matters" (p. 14) if they are to achieve high quality learning outcomes. The dimension of 'Significance' consists of elements which can support students in making connections with new knowledge and building meaning for themselves (NSW Department of Education and Training, 2003b).

Within the NSW model

> *Significance refers to pedagogy that helps make learning meaningful and important to students. Such pedagogy draws clear connections with students' prior knowledge and identities, with contexts outside of the classroom, and with multiple ways of knowing or cultural perspectives* (NSW Department of Education and Training, 2003e, p. 9).

In aligning the NSW model of pedagogy (NSW Department of Education and Training, 2003e) with the components of effective teaching as identified in the work of B. and D. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999) the components of 'building on prior knowledge' and 'integrated lessons' were aligned with Element 13 'background knowledge' and Element 15 'knowledge integration' of the model (Table 2, p. 33). Element 16 'inclusivity' was also considered to have links with the component of 'high expectations' and Element 17 'connectedness' with 'problem solving'. These two components have already been addressed in Dimensions 1 and 2 in this chapter and will not be repeated in this section.

Element 13: Background knowledge

- "Lessons regularly and explicitly build from students' background knowledge, in terms of prior school knowledge as well as other aspects of their personal lives" (NSW Department of Education and Training, 2003e, p. 15).

Building on prior knowledge

The mathematics education literature acknowledges the importance of taking account of students' prior knowledge and experiences in teaching mathematics effectively (Ball, 1988b; Baroody & Ginsburg, 1990; Catholic Education South Australia, 2004; McNeal, 2001). While this perspective is founded on a constructivist view of learning (Ball, 1988b; McNeal, 2001), it is also supported by a wide base of research in cognitive science that links the influence of prior knowledge to the rate of student learning and student performance (Ball, 1988b; Dochy, Segers, & Buehl, 1999).

Baroody and Ginsburg (1990) maintained that children develop their own informal mathematical knowledge, even before they receive any formal training in school. They argued that when children's learning experience builds on their existing knowledge, this leads to the development of positive attitudes, self-regulation and meaningful learning. When learning experiences are linked to previous knowledge students are more likely to understand the mathematics (Ball, 1988b; Catholic Education South Australia, 2004).

Element 15: Knowledge integration

- “Lessons regularly demonstrate links between and within subjects and key learning areas” (NSW Department of Education and Training, 2003e, p. 15).

Teaching for knowledge transfer

Newmann, King and Secada (1996) highlighted the need to make the curriculum authentic by integrating content within and across disciplines in order to make clear the value and meaning of content beyond school. Integrating subject knowledge across the curriculum helps students to identify the meaning, purpose and significance of the what is being learnt (NSW Department of Education and Training, 2003b).

Students do not automatically transfer their knowledge of mathematics from classroom lessons into other areas of their lives or learning (Boaler, 1993; Hurst, 2005). However, Boaler (1993) found that students who learnt in an environment where process and content were integrated, through the use of open-ended activities, were more able to transfer their knowledge into other contexts than students taught in content focused contexts. Open-ended activities more closely reflect the complexities and demands of the real world, enabling students to develop deep mathematical understandings through investigation, discussion and negotiation. Hurst (2005) developed a model of numeracy development, which provided a framework in which students could search for and identify mathematical problems across the curriculum, which promoted both student interest and the transferability of the mathematics learned.

Additional factors

This section details the importance of assessment to quality teaching as evidenced in the NSW model of pedagogy (NSW Department of Education and Training, 2003e, 2004a, 2004b), particularly in relationship to mathematics education. It also includes the attributes of effective mathematics teachers, identified in the mathematics literature as making important contributions to effective mathematics teaching, that do not have connections to the elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

Assessment

The NSW model of pedagogy uses the *Principles for Assessment and Reporting in NSW* description of assessment as a basis for its assessment practice (cited in NSW Department of Education and Training, 2004a):

> *Assessment is the process of identifying, gathering and interpreting information about students' learning. The central purpose of assessment is to provide information on student achievement and progress and set the direction for ongoing teaching and learning* (p. 5).

Assessment is not specified as an element of the NSW model of pedagogy, but is considered a key aspect of the model (NSW Department of Education and Training, 2003e, 2004a). Descriptions of what quality assessment looks like for each of the 18 elements of the model is provided in the initial discussion paper (NSW Department of Education and Training, 2003e), with greater detail and support for implementation being provided in *An assessment practice guide* (NSW Department of Education and Training, 2004a) and *Continuing the discussion about assessment practice* (NSW Department of Education and Training, 2004b). Four of the elements, ‘engagement’, ‘social support’, ‘students’ self regulation’ (in Dimension 2) and ‘inclusivity’ (in Dimension 3) are not included in the coding guidelines of the assessment guide as they “are best observed as elements of classroom practice” (NSW Department of Education and Training, 2004a, pp. 27, 35).

Assessment can be a bridge between learning and teaching, a means of ensuring that learning activities match the learning needs of students

(Wiliam, 2005). This type of assessment involves analysing students' successes and mistakes, trying to identify the thinking behind them (Schifter, 2001) and using that knowledge to plan for future teaching (Clarke, 1997, 1999; Whitin, 2004). Used for this purpose, assessment needs to be ongoing (Whitin, 2004).

Whitin (2004) endorsed the use of assessment tasks that are "accurate and authentic" in demonstrating to teachers what their students can actually do (p. 132). D. and B. Clarke (1999) described a similar type of approach, through the provision of 'rich' assessment tasks. These types of tasks complement more traditional assessments, such as tests, projects and quizzes, and inform both grading and teaching. Rich assessment tasks possess a number of the following features. They:

- "connect naturally with what has been taught
- address a range of outcomes in the one task
- are time efficient and manageable
- allow all students to make a start
- engage the learner
- can be successfully undertaken using a range of methods or approaches
- provide a measure of choice or 'openness'
- encourage students to disclose their own understanding of what they have learned
- allow students to show connections they are able to make between the concepts they have learned
- are themselves worthwhile activities for students' learning
- provide a range of student responses, including a chance for students to show all that they know about the relevant content
- draw the attention of teachers and students to important aspects of mathematical activity
- help teachers to decide what specific help students may require in the relevant content areas" (Clarke & Clarke, 1999, p. 267).

Wiliam, Black and colleagues (Wiliam, 2005; Wiliam, Lee, Harrison, & Black, 2004) reported on a ten-year study conducted to determine whether formative assessment, assessment used to support learning and inform teaching, rather than just quantify results, can improve students' achievement, even when it is measured by state-mandated tests. They found that in a variety of settings, teaching for deep understanding resulted in an increase in student performance on externally-set tests and examinations. They concluded "that attention to higher-order goals in teaching can result in higher attainment, even when such attainment is measured principally in terms of lower-order goals" (Wiliam et al., 2004, p. 50).

The key ingredients of formative assessment, Wiliam (2005) maintained, are effective questioning, clear feedback, making criteria for success clear to all students and assessment that includes peer and self assessment. He also argued that formative assessment looks different in different classrooms but has these distinguishing features: "Students will be thinking more often than they are trying to remember something, they will believe that by working hard, they get cleverer, they will understand what they are working towards, and will know how they are progressing" (p. 34).

Teachers' beliefs and attitudes about mathematics and mathematics teaching

'Beliefs' relate to "an individual's judgement of the truth or falsity of a proposition" (Pajares, 1992, p. 316), whereas attitudes are "enduring systems of positive and negative evaluations, emotional feelings and pro or con action tendencies" (Kretch, Crutchfield, & Ballachey, 1962, p. 139) toward topics, objects or issues. In mathematics education teachers' beliefs and attitudes have been shown to positively or negatively affect the type of learning environment they create (Chapin & Eastman, 1996) and to influence student outcomes (Askew, Brown, Rhodes, Johnson & Wiliam cited in Wilson & Thornton, 2005).

Beliefs

In regard to mathematics education, the beliefs that are relevant are those to do with the nature of mathematics, mathematics teaching and mathematics learning, beliefs that all teachers hold (Baroody, 1987), whether consciously or unconsciously (Jacobs, Yoshida, Fernandez, & Stigler, 1997; Thompson, 1992). Thompson (1992) challenged the notion that beliefs simply influence practice, but argued that the relationship between teachers' beliefs and their practice is an interactive, evaluative and reflective process, where practice also affects beliefs.

Thompson (1992) argued that beliefs about the nature of mathematics can be related to the differing philosophies of mathematics, and that while many teachers of mathematics in primary schools may be unaware of these different philosophies, each has his or her own conception of mathematics. A conception of mathematics is an individual's conscious or subconscious beliefs, concepts, meanings, rules, mental images and preferences concerning mathematics.

Lerman (1983) identified different conceptions of mathematics as falling into two distinct and logically opposed categories: absolutist and fallibilist. While Dossey (1992) categorised them similarly, he used the labels of 'external' and 'internal', 'external' being equivalent to absolutist and 'internal' in line with fallibilist. Skemp (1978, 1979) identified teachers as holding two distinct conceptions of mathematics: instrumental mathematics (rules without reasons) and relational mathematics (knowing what to do and why). He argued that these conceptions of mathematics are so different that teachers are, in fact, teaching two different subjects, depending on which one they hold (Skemp, 1978).

Ernest (1989) distinguished three conceptions of mathematics: the problem solving approach, the Platonist view and the instrumentalist conception. The problem solving approach is embraced by constructivism and sees mathematics as dynamic and problem-driven. Mathematics is perceived as a continually expanding field of human creation, and an invention in which patterns are generated and then distilled into knowledge. The Platonist view understands mathematics to be discovered, not created, that is, a static, unified body of knowledge which is bound by logic and meaning. The instrumentalist conception sees mathematics as a 'bag of tools' consisting of facts, rules and skills, to be used for an external end. Thompson (1992) argued that, while these are three separate conceptions of mathematics, individuals hold aspects of all at the same time, even if they are not consistent with each other.

Beliefs related to mathematics teaching and learning generally fall into two categories, those that agree with active learning theories or those more in line with transmission of knowledge theories of learning. Teachers' professed beliefs are not always consistent with their teaching pedagogy (Thompson, 1992) which may reflect unconscious beliefs about mathematics and mathematics teaching or be constrained by other factors. Teachers can compromise consciously held beliefs about desirable teaching practice because of external pressures (Cooney, 1985; McNeal, 2001; Shield, 1999; Tobin & Imwold, 1993). The context in which a teacher works has a powerful affect on their beliefs and classroom practice, with teachers in the same school often using similar classroom practices (Ernest cited in Thompson, 1992).

Teachers' beliefs about teaching generally relate to their experiences as students (Flores & Day, 2006), but can be modified by their experiences as teachers (Thompson, 1992). While beliefs are stable over time and difficult to change (Pajares, 1992) some preservice and professional development courses, based in constructivist principles, have been shown to facilitate the development of beliefs about mathematics and mathematics teaching consistent with constructivism (Biddulph, 1999; Cady, Meier, & Lubinski, 2006; Hart, 2004; Huinker & Madison, 1995; Mayers, 1994).

Attitudes

Negative attitudes to mathematics are not uncommon among adolescents and adults (Jones, 1997). Many preservice primary and early childhood school teachers enter their tertiary education with negative attitudes to mathematics and mathematics education (Biddulph, 1999; Schuck, 1995, 1996; Wilson & Thornton, 2005), some expressing fear of mathematics and seeing themselves as unable to learn it or teach it effectively (Haylock, 2006). Many student primary school teachers accept mathematics as being unpleasant but necessary, "boring, tedious and difficult" (Schuck, 1995, p. 467). Interestingly, Schuck (1995) noted that some preservice teachers enjoyed the procedural and textbook method of learning mathematics and subsequently were chained to traditional teaching by their own successful schooling experiences. Attitudes to mathematics are very much related to prior experiences as students and can affect teachers' confidence in, and approaches to, mathematics teaching (Hodgen & Askew, 2007; Jones, 1997; Mayers, 1994).

Teachers' knowledge of, and confidence in, mathematics and mathematics teaching

"To be a teacher requires extensive and highly organized bodies of knowledge" (Shulman, 1985, p. 447). Within the discipline of mathematics this knowledge includes an understanding of the relationships and processes of mathematics; knowledge of pedagogy; knowledge of student thinking; the ability to assess student knowledge; and the ability to interpret all of these in order to make instructional decisions (Broekman & Hoffman, 1995; Fennema & Franke, 1992). This type of knowledge enables teachers to act as professionals, rather than technicians, as they will have the intellectual autonomy to make decisions concerning how they should teach mathematics (Steffe & Wiegel, 1992).

The *Standards for Excellence in Teaching Mathematics in Australian Schools* (AAMT, 2002) highlight the need for teachers to have "a sound, coherent knowledge of the mathematics appropriate to the student level they teach" (p. 2). Furthermore they should be "confident and competent users of mathematics who understand connections within mathematics, between mathematics and other subject areas, and how mathematics is related to society" (p. 2). Research indicates that effective primary school teachers have positive views of themselves as learners of mathematics (Wilson & Thornton, 2005). They also have deep and connected understandings of the mathematics they teach (Clarke & Cheeseman, 2000; Mewborn, 2001; Schifter, 2001; Wilson & Thornton, 2005), a depth and sophistication of knowledge often lacking in teachers of these grades (Jones & Southern, 2003; Ma, 1999).

Ma (1999) found that Chinese teachers of elementary mathematics generally had a deeper understanding of fundamental mathematics than their counterparts in the United States of America. Chinese teachers, in fact, begin their careers with a deeper knowledge of the mathematics they are going to teach than most experienced American teachers. She attributed this depth of knowledge to the way they had themselves been taught at school. Ma also identified a group of Chinese teachers who had developed what she describes as a profound understanding of fundamental mathematics (PUFM). This was attained through building on the knowledge they had at the beginning of their careers by intense study of teaching materials, learning mathematics from their colleagues and students and by doing mathematics themselves. She argued that international comparisons of mathematics competency reflected this difference in the superior performance of Chinese students over their American counterparts.

Many preservice primary school teachers have not completed mathematics courses in their senior years of high school (Southwell & Penglase, 2005), readily acknowledge that they have not done well in mathematics at school and/or do not feel prepared to teach mathematics (Jones & Southern, 2003). Many practising teachers are not confident in their mathematics knowledge (Haylock, 2006; Kanes & Nisbet, 1994) or pedagogy (Kanes & Nisbet, 1994).

Teachers have been found to use quite different approaches to teaching content they understand well and content in which they feel unsure (Fennema & Franke, 1992; Swafford, Jones, & Thornton, 1997). When teachers are sure of their content knowledge they are more open to taking risks in the planning and implementation of lessons (Swafford et al., 1997). They are more likely to implement 'reformed' teaching practices and employ more interactive teaching strategies (Fennema & Franke, 1992).

The *Standards for Excellence in Teaching Mathematics in Australian Schools* (AAMT, 2002) describe excellent teachers of mathematics as having a "rich knowledge of how students learn mathematics" (p. 2). They understand the current theories of learning mathematics as well as the development of children's mathematical understandings. The way teachers understand students' thinking is affected by their own mathematical understandings (Warfield, 2001). Their perceptions of student thinking will be quite different if their own understanding or focus is on a procedural, rather than a conceptual, understanding of mathematics and this will affect their responses to student questions or errors (Chick & Baker, 2005). Listening to students, assessing their ideas and identifying the conceptual issues they are engaging in, are skills teachers need to develop to support their students in developing a conceptual knowledge of mathematics (Schifter, 2001).

Having an increased knowledge and understanding, both of mathematics and the way children think and learn, empowers teachers to make instructional choices and to defend and justify them (Simon, 1993a). Yackel and Cobb (1996) maintained that teachers' understandings of students' thinking is crucial to them making informed instructional decisions.

Beswick, Watson and Brown (2006) found that while teachers might hold beliefs about mathematics teaching and learning that are consistent with constructivism, they were often unsure of how to translate them into practice. This is possibly due to the fact that most teachers have not had the opportunity of seeing this type of practice in action (Davis, 1997), which Davis (1997) contended is the most convincing argument for what he called 'experiential' learning.

Teacher reflection

The *NSW model of pedagogy* (NSW Department of Education and Training, 2003e) was developed, not for the purposes of teacher accreditation or external evaluation but as a "framework for teachers' professional self-reflection" (p. 4) and to improve teaching practices. Teacher reflection is considered essential to effective teaching (Clarke & Clarke, 2004; Clarke, 2000; Koehler & Grouws, 1992; Lowery, 2003), a determining factor of a teacher's professionalism (Ticha & Hospesova, 2006). "Teacher effectiveness is not an end product; rather, it is an ongoing, deliberate process. Teacher success is a lifelong pursuit" (Stronge, 2002, p. 64). While it is not easy to reflect on one's own practice (Lowery, 2003) the quality of a teacher's reflections improves with experience (Lowery, 2003; Ticha & Hospesova, 2006).

The conception of the teacher as a reflective practitioner, rather than a skilled technician, has its origins in the work of Dewey and has been more recently advanced in the work of Schön (Grushka, McLeod, & Reynolds, 2005). Schön (1983) introduced the ideas of reflection-in-action, reflection-on-action and reflection-for-action. In essence they highlight the fact that reflection is not simply a retrospective activity, it is part of the whole process of teaching (Clarke, 2000; Ticha & Hospesova, 2006). It is essential in the preparation and planning of learning, undertaking teaching and learning activities, and in assessment and evaluation (Ticha & Hospesova, 2006). In these different contexts the nature of reflection is different, from the spontaneous, automatic responses built on previous experience for the moment-by-moment decisions in the classroom, to the retrospective evaluation of the effectiveness of aspects of teaching (Grushka et al., 2005).

Lowery (2003) maintained that the quality of teachers' reflections influences the quality of their teaching and the levels of student achievement and success. Through reflective practices teachers "acquire critical skills in determining the value of instructional strategies, in assessing students' mathematical understanding, and in developing curricular knowledge" (p. 30) increasing their confidence, autonomy and self-efficacy.

Summary

This chapter has traced the emergence of constructivism as the dominant influence in education, its influence on mathematics education and the quality teaching movement. It was argued that effective mathematics teaching could include teaching from many perspectives, not only constructivism, although it would be consistent with constructivism in being founded on beliefs that students actively acquire knowledge and that effective teaching is based on informed and reflective teacher decisions.

The components of quality mathematics teaching, as identified in the literature by D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997, 1999), were aligned with the more generic elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e). The resulting framework of quality mathematics teaching (Table 2, p. 33) was then used to structure the review of the relevant mathematics education literature, highlighting the appropriate use of components of mathematics teaching to ensure high quality mathematics education.

CHAPTER THREE

Beginning teacher literature

Becoming a teacher

The body of literature on beginning teachers covers a wide range of research using both quantitative and qualitative methods from both sociological and psychological perspectives and multiple philosophical viewpoints. These include studies regarding:

- the process of becoming a teacher, including the influences that affect the beginning teacher;
- the developmental stages of teaching;
- the problems and concerns of beginning teachers; and
- the induction and support of beginning teachers.

The body of literature on the induction, mentoring and support of beginning teachers is very large and usually focused on particular programs designed by the researchers to provide for more effective induction, mentoring and support of neophyte teachers. This thesis is not connected to any particular induction or support program and will, therefore, only touch on induction and support issues as they emerge from the other literature. Hence, this review of literature focuses on the first three areas.

The process of becoming a teacher

The art of teaching is complex (Cole, 1994; Ellsworth & Monahan, 1998) and "not easily separated into clearly distinguished components" (Schools Council, 1990). While the literature describing the process of becoming a teacher is diverse, it is commonly accepted that this process begins long before formal teacher education (Feiman-Nemser, 1983; Lortie, 1975) and continues throughout a teacher's career (Brown & Borko, 1992). While it is a life-long process (Brown & Borko, 1992; Vonk, 1995) the major part of learning to teach occurs in the first five to seven years (Feiman-Nemser, 1983).

Because teaching is complex, the process of becoming a teacher is both complex and demanding (Fuller & Bown, 1975) and the reasons teachers teach the way they do are complex and interrelated (Sparrow, 2000). Hargreaves (Hargreaves & Fullan, 1992b) proposed that explanations of teachers' pedagogy go beyond the teaching skills they have or have not learned. He suggested that a teacher's background, biography, ideals and aspirations (or the frustration of these), as well as the contexts of teaching, including the nature of a teacher's relationship with colleagues and school communities, are all vital in determining a teacher's development (Hargreaves & Fullan, 1992b). Being an intensely human activity, the way individuals teach is dependent on "their own natures, capacities, enthusiasms and beliefs" (Schools Council, 1990, p. 46). While acknowledging the complexities and the interrelatedness of the different factors that determine how a teacher teaches, it is useful to identify these components individually and the possible impacts they have on a teacher.

Factors affecting the process of becoming a teacher

The factors that affect the development of teachers are both internal and external to the teacher and involve three main influences: those from their lives prior to entering teacher education courses; their initial training and professional experience placements; and the contexts in which they teach (Flores & Day, 2006). These do not exist in isolation and are mutually influential (Bullough, 1997), they are not static or unchanging and their influence on individual teachers can be unpredictable and inconsistent (Gill, 1998).

Prior influences

Personal disposition/personality

Several studies have proposed that characteristics relating to personality or disposition play a significant role in the development of a teacher, in fact

Lortie's seminal (1975) sociological study of the school teacher suggested that the teacher's personal predisposition stands "at the core of becoming a teacher" (p. 79). From a psychological perspective Fuller and Bown (1975) claimed that the notion of a 'born' teacher may well be true, with the choice of teaching being "rooted in early psychodynamic processes, so that teaching is an expression of early yearnings and fantasies" (Wright & Tuska cited in Fuller & Bown, 1975, p. 35). The notion of the born teacher, however, has not gone unchallenged with Britzman (1986) describing it as a myth, with an associated danger of undervaluing professional preparation in teacher development.

Stephens (cited in Fuller & Bown, 1975) suggested that teachers exhibit two kinds of "spontaneous tendencies" which incline them to teaching: firstly to be playful and manipulative; and secondly "to talk, applaud, correct, prompt others, and point the moral" (Fuller & Bown, 1975, p. 35). Furthermore, Fuller and Bown (1975) found that primary school teaching tends to attract people who are warmer, more hopeful, supportive, directive and exhibitionistic than those who enter secondary school teaching.

More recently Ellsworth and Monahan (1998), while not defining a 'teaching personality', listed "a set of dispositional behaviours...[that] seemed to make teaching easier" (p. 76)[6] These included aspects of appearance, levels of enthusiasm, communication skills with both students and peers, problem solving abilities, cooperative skills, integrity, reliability and flexibility. Gill (1998) found that novice teachers' individual temperaments were significant in their evaluation of their own developmental progress and resulted in radically different perceptions of almost identical situations. Hebert and Worthy's (2001) case study of one beginning teacher's 'successful' first year attributed her 'success' principally to her 'high energy', positive and confident personality and her associated behaviours.

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[6] This was within the context of a program of University and Public School partnerships established to enhance the development of preservice teachers through the Northern Arizona University Center for Excellence in Education.

Interestingly, teaching also necessitates suppressing elements of one's personality or disposition and developing a suitable persona (Ryan, 1970). It "involves daily, intensive and extensive use of both emotional labour (e.g. smiling on the outside while feeling anything but happy on the inside) and emotional work which enables teachers to manage the challenges of teaching classes which contain students with a range of diverse motivations, personal histories and learning capacities" (Flores & Day, 2006, p. 221). Teaching requires a great deal of emotional and physical energy (Schools Council, 1990).

Background/Biography

The beginning teacher's biography, including both her personal and professional history, has been identified as being a powerful influence on the process of becoming a teacher (Feiman-Nemser, 1983; Flores & Day, 2006; Hargreaves & Fullan, 1992b; Knowles, 1988, 1994; Novak & Knowles, 1992). Her biography influences her motivations for deciding on teaching as a career (Flores & Day, 2006) and the preconceptions of teaching she brings with her into her first year of teaching (Goddard & Foster, 2001). It shapes her practice (Knowles, 1994; Novak & Knowles, 1992) and influences the development of her professional identity (Flores & Day, 2006; Knowles, 1988, 1992). Aspects of her biography including her experiences as a school student (Knowles, 1992; Lortie, 1975) and student teacher (O'Loughlin, 1989), her family history (Knowles, 1992), her current family circumstances and responsibilities (Fessler & Christensen, 1992a; Knowles, 1988), and the context in which she is teaching (Gill, 1998; Knowles, 1988) have all been identified as having some influence on the process of becoming a teacher.

Experiences as a school student

A novice teacher enters into her career with more first-hand experience of her workplace and occupation than novices in any other profession. The beginning teacher has undertaken an "apprenticeship of observation" (Lortie, 1975, p. 61) for eleven to fourteen years of formal education prior to commencing a teacher education qualification. Furthermore, as a school student her experiences have not been passive observations but relational interactions, usually in situations where she has had less power than her teacher. In her interactions with teachers she has often imagined herself in the role of her teacher in order to anticipate the teacher's probable reactions to her behaviour (Lortie, 1975). The familiarity of the classroom develops "well-worn and commonsensical images" (Britzman, 1986, p. 443) of teaching and leads the beginning teacher to believe she knows what teaching is all about (Ryan, 1970; Weinstein, 1990). This belief is often challenged by the shock realisation that the observation of the role of teacher is very different from being in the role of teacher. What once appeared to be familiar can be encountered as a startlingly new situation (Ryan, 1970).

The conceptions both preservice and novice teachers have of teaching are very often tied to their experiences as students (Goddard & Foster, 2001; Knowles, 1992). These conceptions usually focus strongly on the affective, interpersonal dimensions of teaching (Bullough, Knowles, & Crow, 1989; Wang & Odell, 2002; Hollingsworth 1989 cited in Weinstein, 1990). These include ideal images of the role of the teacher as guide, confidante and friend (Calderhead, 1988) focusing on sharing, nurturing and managing with little regard for students' academic learning (Bullough et al., 1989; Wang & Odell, 2002; Hollingsworth cited in Weinstein, 1990). Furthermore, they often attribute student learning to teachers' personalities or management rather than to their pedagogical choices (Wang & Odell, 2002).

Individual teachers can have a great influence on novices' views of teaching (Knowles, 1992), even influencing their choice of teaching as a career (Wang & Odell, 2002). These influences are not always positive, but when teachers are admired their characters are often associated with the characteristics of "flexibility, motivation and fairness" (Flores & Day, 2006, p. 223).

Novices' experiences as students also provide them with a frame of reference in making sense of their initial teaching experiences and in developing an understanding of themselves as teachers (Flores & Day, 2006). The positive and negative experiences from their own student days are resources novice teachers draw upon (Ryan, 1970) and models they emulate or avoid in responding to the practical situations they face day-to-day (Flores & Day, 2006).

The influence former teachers have on novice teachers indicates that beliefs, formed prior to entering teaching, play a major role in beginning teachers' approaches to teaching and how they think of themselves as teachers (Flores & Day, 2006). In the previous chapter we looked at the literature pertaining to teachers' and students' beliefs about mathematics and mathematics education. In this chapter we will look at beginning teachers' beliefs about teaching generally.

Beliefs

The origin of a novice teacher's beliefs about teaching, classrooms and schools is largely attributed to her role as a student (Flores & Day, 2006), as well as the influence of her family and her personality (Kagan, 1992; Knowles, 1988; O'Loughlin, 1989). Bullough (1997) maintained that, along with prior experience and the context of teaching, beliefs "are central to shaping the storyline...of becoming a teacher" (p. 95). The literature examines the nature of these beliefs and their impact on preservice and novice teachers in their initial teaching experiences.

The novice teacher's 'apprenticeship-of-observation' (Lortie, 1975) lays the basis for "traditional, intuitive approaches to teaching" (p. 81). This view is confirmed by Feiman-Nemser, McDiarmid, Melnick and Parker (1989) who found that preservice elementary school teachers begin their teacher education courses believing that "teaching is telling" (p. 2) and that learning is reiterating what the teacher says. This belief fits within the 'traditional' model of teaching (Smith, 1996) described in Chapter Two.

Britzman (1986) found that many student teachers hold the belief that good teaching is a polished performance in controlling students and learning. Therefore, they desire to learn as many techniques as possible in order to emulate this type of performance with which they are so familiar as students. As a result, preservice teachers "actively seek confirmation and elaboration" (O'Loughlin, 1989, p. 10) of this belief in their preservice courses, professional experience placements and teaching experiences.

O'Loughlin (1989), using Sigel's (1985) conceptual analysis of beliefs, categorised teacher preparation programs, professional experience placements and actual teaching as "change agents" (O'Loughlin, 1989, p. 4). However, beliefs are well established by the time students commence teacher preparation courses, they are stable over time and difficult to change (Pajares, 1992). Many student teachers' initial beliefs about teaching and learning are still intact at the end of preservice courses (Kagan, 1992; Knowles, 1992; Weinstein, 1990). This is borne out by O'Loughlin (1989) in his summary of teachers' beliefs as described in the literature. He maintains that most teachers not only believe teaching "to be a tight didactic, authoritarian activity" (p. 7), they also teach in a manner consistent with this belief (O'Loughlin, 1989).

In contrast to this, Hart (2004) found that beginning teachers, who were trying to implement teaching practices consistent with reform, maintained their beliefs about the importance of these practices even while struggling to implement them. She found that the novice teachers in her study were very constant in holding their beliefs but they lacked the confidence and experience to implement them consistently. McNeil's (1986) research found that the effects of institutional restraints and contextual forces often led to dissonance between teachers' held views and their teaching practices. Beliefs, then, can be very poor predictors of behaviour (Sigel, 1985).

Preservice course

The literature on the influence of university preservice courses, while consistent in some areas, holds several anomalies. We have seen that preservice teachers come to teaching with traditional views of teaching and learning (Lortie, 1975; O'Loughlin, 1989). It is also true that both beginning and experienced teachers often adopt traditional approaches to teaching and learning (Lortie, 1975; O'Loughlin, 1989; Zeichner & Tabachnick, 1981) and much of the research into the effects of preservice courses has been undertaken within the context of investigating the reasons for this. Zeichner and Tabachnick (1981) found that research presented three alternative views about the impact of the university on the student teacher:

- nonexistent - the traditional views of teaching and learning with which preservice teachers enter their university programs are not changed in the course of their studies;
- conservative - universities contribute to the development of traditional teaching perspectives; and
- liberal - the university has a liberalising influence which, over a period of time, shifts back to traditional teaching perspectives. This is the most commonly held perspective.

It is generally acknowledged that by and large teachers believe they learn to teach from experience (Calderhead, 1988; Clark, Smith, Newby, & Cook, 1984; Feiman-Nemser, 1983; Flores & Day, 2006; Lortie, 1975). This is consistent with Fuller and Bown’s (1975) description of formal teacher education as "a ritual parallel to, but essentially irrelevant to, the real business of learning to teach" (p. 29). Coupled with this is the opinion many teachers have that their preparation at university was inadequate for the complex and demanding nature of their jobs (Flores & Day, 2006).

This irrelevance and/or inadequacy is often attributed to the 'gap' between the theory taught in these courses and the 'reality' of teaching (Flores & Day, 2006; O'Loughlin, 1989). Feiman-Nemser (1983) credited this gap to teachers’ perceptions that preservice courses are “too theoretical and not sufficiently practical” (p. 155). O'Loughlin (1989) maintained that it is caused by preservice courses being taught without making connections with the reality of schools. This, he claims, leads to students failing to make links between theoretical and practical knowledge and results in student teachers dismissing theoretical material as impractical.

Zeichner and Tabachnick (1981) suggested the barrier to beginning teachers embracing the theoretical perspectives promoted in university courses is the inconsistency between the professed pedagogy of these courses and the pedagogy actually practised in them. Whereas Cook, Smagorinsky, Fry, Konopak and Moore (2002) attributed it to these courses failing to promote conceptual development by having “no unifying principles” (p. 412) across the curriculum. Kagan (1992) argued that preservice teachers are “often presented with inconsistent and contradictory views of teaching and learning” (p. 154). O'Loughlin (1989) accused universities of contributing to the reproductive cycle of traditional teaching by failing to challenge students to examine and own a "coherent set of core beliefs" (p. 12) and as a result, apparently confirming student teachers' existing traditional beliefs.

Teacher preparation courses and professional experience placements can be seen as agents of change (O'Loughlin, 1989). Indeed, we have seen that several preservice courses have claimed some success as change agents; altering the beliefs, attitudes and practices of preservice teachers (Bobis & Cusworth, 1994; Bolick, 1996; Bright & Vacc, 1994, April; Martinez, 1992; Mayers, 1994). Some research claims that it is the process of socialisation into schools that is largely responsible for beginning teachers abandoning university principles and adopting those of schools (Borko et al., 1992; Ritchie & Wilson 1993 cited in Cook et al., 2002; Zeichner & Tabachnick, 1981). This process begins with the professional experience placements but continues into the first years of teaching.

Professional experience placements

University professional experience placements are often stressful for student teachers, with heavy teaching workloads, assignments associated with course work, lack of support and the pressures of assessment of performance, factors commonly reported as contributing to tiring and stressful experiences (Flores & Day, 2006).

Flores and Day (2006) argued that the theory taught in preservice courses influences the development of beginning teachers’ teaching ideals, which in turn leads to "inner and practical tensions" when beginning teachers are confronted with "the complex and demanding reality" of teaching (Flores & Day, 2006, p. 224). It is often on professional experience placements that preservice teachers first encounter a mismatch between their beliefs and their practice by assuming a "strategic compliance" attitude (Lacey 1977 cited in Flores & Day, 2006, p. 225) in following their supervising teachers' perspectives regardless of their own reservations. Commonly they adapt to the contextual constraints of their role (Smith & Lowrie, 2001; Vonk, 1993). As a result of these professional experience placements, student teachers perceive themselves as having become more traditional and teacher-centred in their pedagogy (Flores & Day, 2006). This process continues in the years following graduation (Smith & Lowrie, 2001; Zeichner & Tabachnick, 1981).

Context

The context in which a novice teacher begins her career includes her place within the school community, her stage in the life cycle and its associated family relationships, and social and community commitments.

Vonk (1995) argued that a beginning teacher develops in a specific school context. She adapts to her particular school, her own department/Stage and her own class/classes, and all of the responsibilities and concerns connected with them. She negotiates relationships with students, colleagues, administration, supervisors and parents and tries to understand and navigate her way through the expectations of them all. Kelchtermans and Ballet (2002) established that the micropolitics of a school community is so complex, and its potential to impact the progress of the beginning teacher so critical, that the beginning teacher needs to develop skills in 'reading' the micropolitical reality of her school and 'writing' herself into it.

Vonk (1984; 1995) identified three strategies beginning teachers use in the process of adapting to the circumstances in which they find themselves.

They:

- adopt the culture - those who feel familiar with the existing school culture; or
- adapt strategically – those who feel they should show their colleagues and students that they are able to function within the culture before changing their teaching approach; or
- follow their own pace – those who do not agree with the existing culture and are unwilling to adapt. Those who follow this route only survive if they have considerable tolerance to frustration.

Gill (1998) found the culture of a school, including the social and political circumstances influencing the school, has a profound impact on the novice teacher, sometimes overtaking issues such as personal competence or success. However, she noted that while the context in which a teacher works is extremely important in facilitating a beginning teacher's progress, teachers in almost identical situations can perceive them quite differently. She concluded that an individual's temperament is of equal importance in the growth of the novice teacher.

Flores and Day (2006) found that a positive context, where the school leadership is "supportive, informative and encouraging" (p. 230) and staff enjoy positive working relationships, leads to the novice having positive attitudes to teaching. In negative contexts many beginning teachers withdraw from their colleagues and leaders, feeling that their initial trust in them has been betrayed. As in the professional experience placements discussed earlier, these novices protect themselves by taking a "strategic compliance" attitude (Lacey 1977 cited in Flores & Day, 2006, p. 229).

Some research claims that the process of socialisation into schools is largely responsible for beginning teachers abandoning the liberal philosophies acquired through university courses and adopting the more traditional principles of schools (Borko et al., 1992; Ritchie & Wilson 1993 cited in Cook et al., 2002; Zeichner & Tabachnick, 1981). Wells (1984) reviewed the literature regarding the socialisation process and found that neophyte teachers “must adopt traditional teaching methods and values if they are to become accepted by their colleagues and be respected as professionals” (Wells, 1984, p. 4). In this process the impact of university courses is ‘washed out’ by school experience (Zeichner & Tabachnick, 1981, p. 7).

Beginning teachers are often, but not always, in their early twenties, having gone directly into their teacher training courses from school and then straight into teaching (Fessler & Christensen, 1992a). Hargreaves and Fullan (1992a) suggested that because of their position within the life cycle, young teachers characteristically have a great deal of physical energy, few domestic commitments, high ideals and a willingness to invest strongly in work and innovation. This was certainly found to be true in Hebert and Worthy’s (2001) case study of the successful first year of one beginning teacher. They noted that her success was largely attributable to her high energy personality and the fact that she could devote herself completely to her job, her school and to her students because she was living at home with her parents and had limited personal responsibilities.

However, young teachers are also in the stage of life where they are seeking out life partners and looking to establish themselves independently (Ryan, 1974). Ryan (1970) found that when one of the participants in his study was focused on her upcoming wedding and maintaining a long-distance relationship with her fiancé, her job became an irritant, making demands she was unwilling to meet.

However, not all beginning teachers commence their careers in this stage of life and a substantial number of mature age students are completing preservice teaching courses (Haipt, 1990; Powell, 1997). Haipt (1990) found that teacher educators appreciated teaching mature age students because of their diligence in completing their courses and their commitment to teaching as a profession. Hargreaves and Fullan (1992a) have looked at the experiences of veteran teachers in terms of the life cycle, but made no reference to its impact on mature age beginning teachers. They found that veteran teachers in midlife are more aware of their mortality and declining physical powers than younger teachers. They are often intent on maintaining a balance between work and the rest of their lives and have become more cautious about change.

Stages of teacher development

Research into the development of teachers has suggested that teachers pass through a number of developmental stages from their entry into preservice teacher education courses until they retire or leave the profession (Berliner, 1988; Fuller & Bown, 1975; Katz, 1972). There is a substantial body of research that seeks to define these developmental stages beginning with the early seminal work of Katz (1972) through to the more recent work of Goddard and Foster (2001). While some of the proposed models have become more sophisticated and multifaceted (Sparrow, 2000) they still have many similarities to the earlier work on which they build. It is interesting to compare the development of these models and note their similarities and differences (see Table 4, p. 85).

The early models of the stages of teacher development are linear in nature and, while they gave an overview of a teacher's career, their detail focused on the beginning stage which most referred to in some way as 'survival' (Burden, 1982; Feiman-Nemser, 1983; Fuller & Bown, 1975; Katz, 1972; Ryan, 1986). They commonly noted that teachers progress through the various stages at different rates but gave some guidelines as to the most common experiences (Berliner, 1988; Feiman-Nemser, 1983; Katz, 1972).

Fuller's (1969) earlier research and later with Bown (Fuller & Bown, 1975), noted that the stages of learning to teach were described, in the research, in terms of the concerns teachers experienced in these stages. Ryan, (1986) using the work of Fuller (1969), focused on the concerns and difficulties encountered in the early career stages of Fantasy and Survival in order to develop appropriate support for beginning teachers. Feiman-Nemser (1983), in consolidating the descriptions of the stages of teacher development in the literature, described the stages in terms of features that characterised them.

Table 4 Comparison of models of stages of teaching

Comparison of Theoretical Models of Stages of Teacher Development					
Model	Preservice	Year 1 - 2	Year 2 - 3	Year 3 - 4	Year 5 and beyond
Katz (1972)		Survival: **1 to 2 years**	Consolidation: **3rd year**	Renewal **4th year**:	Maturity: **5th year and beyond**
Burden (1982)		Survival 1st year	Adjustment 2nd to 4th years		Maturity 5th year and beyond
Fuller (1969) Fuller & Bown (1975) Model of concerns	Pre-teaching **Non concern** Survival concerns	Early teaching **Concern with self**	Late concerns **Concerns with pupils**		
Feiman-Nemser (1983)		Survival: **1st year**	Consolidation: **2nd to 4th years**		Mastery: **remainder of career**
Ryan (1986) used the work of Fuller (1969)	Fantasy:	Survival: **1st year**	Mastery:	Impact:	
Dreyfus and Dreyfus (1986) - used by Berliner (1988)		Novice: **student teachers & many 1st year teachers**	Advanced beginner: **many 2nd& 3rd year teachers**	Competent: **many 3rd & 4th year teachers**	Proficient: **modest number of 5th year teachers** Expert: **small number of teachers**
Huberman (1989)		Survival & discovery: **career entry**	Stabilisation: **after 3 to 4 years**		Experimentation /activism Taking stock /self-doubts: **12th-20th years** Serenity: **45-55 age group** Conservatism: **50-60 age group** Disengage-ment
Vonk (1989)	Pre-professional:	Threshold: **1st year**	Growing into the profession:	1st professional:	Reorientation: 2nd professional: Running down: **a few months to several years**
Fessler and Christensen (1992b)	Preservice:	Induction:	Competency Building:	Enthusiastic & growing:	Frustration: **Not always experienced** Career stability: **Not always experienced** Career wind-down: **At any time** Exit: **At any time**
Bullough & Baughman (1995) Baughman's labelling of herself		Follower **emulating her mentor – 1st year**	Follower/ Independent **2nd year** Independent **3rd year**	Independent /Mastery **4th year**	Her future career
Goddard & Foster (2001)	Archetype Approaching the gates	Clearing the gates Gloss wears off Disillus-ionment	Alternative routes across the Rubicon ⇨ **Reflective practitioner or Competent complacent or Ex-teacher**		

Key		
Unbroken line = set period	**Broken line = merging periods**	**Zigzag line = no time specified**

The survival stage is characterised by limited knowledge, feelings of uncertainty, confusion and insecurity (Burden, 1982); the consolidation stage by growing confidence and mastery; and the mastery stage by confidence and ease (Feiman-Nemser, 1983).

In a five stage model Dreyfus and Dreyfus (1986) theorised phases which one moves through in the process of gaining expertise in any field. This model was supported by Berliner's (1988) research into the process of the professional development of the teacher. Berliner (1988) maintained that "very important qualitative differences exist in the thinking and the performance of novices, experts and all those who fall between these two points on the continuum" (p. 59). The behaviour of the novice is "very rational, relatively inflexible, and tends to conform to whatever rules and procedures the person was told to follow" (Berliner, 1988, p. 41). The advanced beginner is beginning to respond to context, but still developing a sense of priorities. The competent teacher is distinguished by making conscious choices about what they are going to do, they set priorities and make achievable plans. The proficient teacher has developed 'know-how' and responds intuitively based on her prior experience. The few teachers who become experts show 'fluid' performance, while still intuitive they seem to act effortlessly rather than rationally or analytically. Berliner characterised their behaviour as arational (Berliner, 1988). Flyvbjerg (2001) noted the qualitative jump from the first three levels of this model to the fourth and fifth levels, where rule-based thinking as a basis for action is replaced with context and intuition. "Logically based action is replaced by experientially based action" (Flyvbjerg, 2001, p. 21). Berliner (1988) argued that, due to the complicated nature of teaching, the development of expertise may take a long time and that extensive experience is fundamental to its development.

Huberman (1989) expanded on these models, identifying strong trends in the literature which fleshed out the stages of development throughout teachers' careers. He noted that while the first two stages were strongly supported by the literature, there was a divergence of perspectives regarding the latter stages. The stages are strongly linked to the life-cycle. The Schools Council

(1990) used this model in their *Australia's Teachers: An agenda for the next decade* document, clarifying that early career teachers are usually in the first two stages of survival/discovery and stabilisation.

In line with this model Vonk (1989), and Fessler and Christensen (1992b) proposed models which illuminated the complexities of a teacher's development and saw them more in terms of cycles where teachers might enter and exit stages in the cycle numerous times in the course their careers.

Bullough (1989), in his longitudinal study of Kerry Baughman's first years as a teacher, characterised Kerry's development as a teacher using Ryan's (1986) proposed stages. Interestingly, in his five-year follow-up he asked Kerry to review her career and provide an overarching name or theme in line with Huberman's (1989) methodology. She identified and labelled the stages of her own development and characterised them in terms of her major concerns in each phase:

- Follower – emulating her mentor – first year of teaching – discipline and curriculum development were her major concerns;
- follower/independent – took on a leadership role – second year of teaching - student motivation was her major concern;
- independent – felt powerful and building a reputation – third year of teaching - student motivation was still her main concern;
- independent/mastery – independent of other faculty members and in control of her teaching – this transition took place in her fourth year of teaching – motivation was still a concern but she felt she had achieved this with the vast majority of her students.

In their investigation of teacher development, Hargreaves and Fullan (1992a) highlighted the fact that this process does not occur separately from the life cycle. The effect of this for young novice teachers is that their progress as teachers will mirror their personal growth and development. On a negative note, this suggests that their highest level of development may not be reached for several years, but on the positive side they will have high levels of physical energy, few domestic commitments, high ideals and a willingness to invest strongly in work and innovation. This study noted that mid- to late-career teachers are usually in midlife, which is characterised by a determination to maintain a balance between work and the rest of their lives and being cautious about change. However, it did not address the issue of mature age novice teachers in terms of how their place in the life cycle might influence their experiences as beginning teachers.

Kagan's (1992) review of 40 learning-to-teach studies focused on the professional growth of preservice and beginning teachers. Kagan identified an initial stage in teacher development that occurs in the preservice professional experience placements and first-year of teaching. In this stage trainee and/or novice teachers focus on themselves. Their preoccupation with monitoring their own behaviour, as they attempt to implement workable procedures, prevents them from focusing on their pupils' learning. Kagan noted that novices can only move on from this stage when they have acquired a range of workable procedural routines.

While focusing on the first five years of teaching, Goddard and Foster (2001) identified six stages of development. The first five phases of this paradigm could be seen as substages of the Preservice and Survival stages of the other models (Table 4, p. 85) and are consistent with those models in their detail. Kagan (1992) also focused on the early career stage and identified five components of behavioural and conceptual growth that occur within this period. She did not present it as a model of development, in the sense of identifying a sequence or cycle of stages, but more as an identification of particular components of behaviour and understanding that change throughout his period. Novices:

- become aware of what they know and believe about pupils and teaching and how that knowledge is changing;
- reconstruct their idealised and inadequate images of pupils and themselves;
- shift attention from themselves to designing instruction to enhance pupils' learning;

- develop standard procedures and routines which integrate instruction and management and become increasingly automated; and
- develop problem solving skills which lead to the ability to generalise aspects of their teaching repertoires.

In NSW, the introduction of the *Professional Teaching Standards* (NSW Institute of Teachers, 2005a) has seen four key stages of teacher development identified and formalised for the purposes of monitoring and moderating teacher quality. These are: graduate teacher; professional competence; professional accomplishment and professional leadership. To be professionally accredited teachers are assessed against the standards appropriate to each stage of development, in terms of their professional knowledge, professional practice and professional commitment.

The route to expertise

The term 'survival' is very commonly used to describe the early stage of teacher development (Fuller, 1969; Goddard & Foster, 2001; Katz, 1972; Lang, 1999; Lortie, 1975; Manuel, 2003b; Ryan, 1986; Veenman, 1984; Vonk, 1984). Berliner (1988) suggested that the real goal of the beginning teacher, in this stage, is to muddle through until it starts to make sense. He characterised the novice in this phase as tending to conform to the rules and procedures they have been told to follow. Ryan (1986) characterised the beginning teacher in this period as fighting for her professional life, her sense of worth and her identity. Opposite terms such 'sad' or 'joyous' (Ryan, 1970) and 'easy' or 'painful' (Huberman, 1989) have been used to describe the early career experiences of teachers. Regardless of whether this time is positive or negative it is a period of intense learning for all beginning teachers (Ryan, 1970).

Berliner (1988) argued that novice teachers are too inexperienced to have developed a taxonomy of student errors, a prerequisite for predicting student thinking and the kinds of mistakes they will make. These predictions are fundamental to a diagnostic-prescriptive form of teaching. In contrast to this, experienced teachers have thousands of hours of experience in which to develop their interpretive abilities as well as acquire routines which support a smoothly functioning classroom. Not surprisingly then, studies comparing the teaching of experienced and novice teachers (Berliner, 1987, 1988; Fuller, 1996; Leinhardt, 1983; Leinhardt & Greeno, 1986; Leinhardt & Smith, 1985; O'Connor & Fish, 1997, 1998; O'Connor, Fish, & Yasik, 2004) have consistently found differences in the thinking and actions of these two groups (Brown & Borko, 1992).

In the studies comparing experienced and novice teachers, some studies have incorporated the notion of an 'expert' teacher, rather than just an 'experienced' teacher. The criteria for judging a teacher as expert differs from study to study but can involve the opinion of school principals and peers as well as students' performances in tests (Allen & Casbergue, 2000; Berliner, 1987; Leinhardt & Smith, 1985; Manning & Payne, 1996; O'Connor & Fish, 1998). In any field experts have abilities that are not found in novices (Berliner, 1988). "To the novice, the expert appears to have uncanny abilities to notice things, an 'instinct' for making the right moves, an ineffable ability to get things done and to perform in an almost effortless manner" (Berliner, 1988, p. 39).

Berliner (1987), in finding differences between the thinking and actions of novice and expert teachers, found inconsistencies within these groups. Some experts evidenced less refined patterns of thinking than others and some very inexperienced novices elicited quite sophisticated patterns of thinking. He surmised that these novices were likely to progress to experts very quickly and concluded that expertise and experience are not synonymous. While "experience might be the best teacher...[it]...does not teach everyone equally well" (Berliner, 1987, p. 77).

Leinhardt and Greeno (1986) also studied expert and novice teachers, within the context of mathematics lessons, and found the major difference between the two groups was the use of routines. Expert teachers use well-practised routines, in contrast to novices, whose lessons involve different formats everyday, requiring extra time and energy in explanation and organisation. The use of routines allows the teacher to focus on the substance of the lesson as well as monitoring how the lesson is progressing. They reduce the cognitive load of teachers, providing them with the intellectual room to deal with the dynamics of the classroom.

Interestingly, expertise as a teacher is not necessarily transferable to all contexts (Berliner, 1988; Bullough & Baughman, 1993). Berliner (1988) found that when placed in unfamiliar contexts or teaching unfamiliar lessons expert teachers exhibit behaviours typical of novices. Bullough and Baughman (1993) noted that in her fifth year of teaching Kerry Baughman reverted to feeling, thinking and acting like a novice when faced with new challenges.

Berliner (1988) concluded that the process of developing expertise as a teacher requires extensive experience due to the complexities of teaching. Consequently, he asserted, expectations of novices should be adjusted to accommodate their inexperience, requiring the demonstration of minimal skill while they acquire the necessary experience on which to build proficiency. He suggested that beginning teachers need to be supported by the use of lesson prototypes and teaching manuals and not be expected to be creative lesson planners bringing new insights to the curriculum.

Concerns and problems of beginning teachers

Ryan (1974) maintained that it is the norm for beginning teachers to experience severe problems in their early career and that often the experience of the first year is “turbulent, frustrating and painful” (p. 2). He (Ryan, 1974, 1986) classified these concerns into categories relating to:

- culture shock – similar to the experience of being immersed in another culture – fatigue, disorientation and feeling mistaken at being there;
- instruction – ‘what works’, resources, lack of skills and strategies;
- students – discouraging – difficulties understanding them, working out an appropriate social distance, discipline;

- parents – working out these complex relationships;
- fellow teachers – jealousies and petty concerns, isolation and being ignored;
- administrators – particularly the different roles of the principal, differing perspectives and the problem of authority; and
- self-doubt – “a year of insecurity and isolation” (Ryan, 1974, p. 23).

The work of Fuller and Bown (Fuller, 1969; Fuller & Bown, 1975) highlighted that research on stages of teacher development was largely defined in terms of clusters of teacher concerns. They identified survival concerns as largely related to the preservice phase of career development but, as we have seen, many studies have identified survival as the common experience of countless novice inservice teachers (Feiman-Nemser, 1983; Goddard & Foster, 2001; Huberman, 1989; Lang, 1999; Lortie, 1975; Manuel, 2003b).

Gratch (1998), in her review of the literature, found that these concerns and problems have remained consistent over time. This is borne out in a comparison of the compilations of difficulties identified in the following table (see Table 5, p. 93).

Behaviour management issues are the most common facing beginning teachers (Friedman, 2000); always listed at the top of novice teachers' difficulties and concerns (Gratch, 1998; Veenman, 1984). Interestingly, "failure to maintain discipline" (Schools Council, 1990, p. 123) is the most common reason by far for dismissal from teaching (Kenny, 2000; Schools Council, 1990). There is no doubt that an orderly classroom is a necessary prerequisite for constructive learning (Schools Council, 1990; Stronge, 2002), but for beginning teachers the need to maintain classroom control is related to their sense of themselves as successful teachers (Flores & Day, 2006). Teachers tend to judge themselves and others on the basis of their classroom control (Britzman, 1986).

Table 5 Comparison of beginning teacher concerns

Comparison of beginning teacher concerns as identified by researchers			
Problems	**Veenman (1984)**	**Gratch (1998)**	**Sparrow (2000)**
Discipline	1	1	1
Student differences	2	7	4
Assessment	3	-	5
Parents	4	4	-
Organising classwork	5	5	2 Time constraints 3 Covering syllabus 6 Planning for maths
Resources	6	2	-
Student problems	7	7	-
Classroom organisation	-	3	-
Motivating students	-	6	-
Isolation	-	-	7
Demands of personal lives	-	-	8

Numerals represent the priority given in each study

One first-year teacher (Morgon, 1997) expressed her concerns, in an open letter to more experienced teachers, asking for help with the practicalities and politics of school life. She requested collegial support in relieving some of the stresses of being a new teacher, asking for opportunities to observe her more experienced colleagues and help in setting priorities. Her letter highlights the desire to feel connected with her colleagues and her feelings of isolation.

Morgon (1997) is not alone in this. Teaching has often been called a lonely profession (Feiman-Nemser, 1983; Lortie, 1975). Teachers work largely in isolation (DeWert, Babinski, & Jones, 2003; Goddard & Foster, 2001; Hobson, 1996; Huberman, 1989; Karge, 1993), and this involves them making hundreds of decisions a day, in all likelihood, alone and unassisted (Jackson, 1968). Gratch (1998) maintained that teacher autonomy is often assumed, when in fact, isolation is the reality of being a teacher.

In order to alleviate the difficulties experienced by beginning teachers Page, Marlow and Molloy (2000) identified four needs:

- employment in schools which espouse philosophies that match their own;
- support in planning, programming, classroom organisation and paperwork;
- time and opportunities to talk to other new teachers; and
- a balanced life - a life apart from school.

Reality shock

While undertaking any new job involves stresses and difficulties the initial experience of taking on the full responsibilities of a teacher is often described as a 'reality shock', and has been documented over a long period of time (Friedman, 2000; Huberman, 1989; Lang, 1999; Lortie, 1975; Manuel, 2003b; Ryan, 1974, 1970; Veenman, 1984). The change from being a student teacher to taking on the responsibility for a full-time classroom environment is a “quantum leap” (Department of Employment Education and Training, 1989, p. 123). So difficult is this period that is often seen as a 'baptism of fire', where new teachers can be left to 'sink or swim' (Clyde & Ebbeck, 1990).

The nature of the socialisation of teachers, as described earlier, contributes to this shock, with new teachers taking on the full quota of teaching duties from their first day on the job (Lortie, 1975). A mismatch between teachers’ expectations and ideals and the realities of teaching is also a contributing factor (Friedman, 2000).

When Lortie (1975) identified the difficulties beginning teachers had coping with the full quota of teaching duties from the first day on the job, he noted that in other apprenticeship situations novices are exposed to tasks in order of ascending difficulty. Considering the degree of responsibility and the lack of experience, it is little wonder that the first months of teaching can be an ordeal (Lortie, 1975). This situation has changed little over the last 30 years. Beginning teachers, in Friedman's (2000) study, who experienced 'burnout' as a result of their experiences in the early stages of teaching, used descriptions such as: "'shock', 'nightmare', 'catastrophe', 'collapse', 'despair', 'crisis', and 'pressure' to describe their first weeks in teaching" (p. 598).

While taking on the full responsibilities of a classroom teacher is the norm for beginning teachers, it is also not unusual for beginning teachers to be allocated the least desirable teaching assignments, the least desirable classrooms with the most challenging children (Cole, 1994; Patterson, 2005). Huberman (1985) and Manuel (2003b) add to this picture the concept that the early experience of the novice teacher is not just a 'baptism of fire' but a 'rite of passage' into the profession of teaching. This is a disturbing idea as it is not only descriptive of her experiences but suggests that she is undergoing a form of initiation into the profession of teaching, the right to be called a teacher (Ryan, 1974).

White (2005) questions why so many teachers are harsh towards newcomers to the profession. She raises three possibilities: that having experienced such hardship themselves they have developed a "sink or swim" attitude: or the intensity of teaching has hardened them to the beginning teacher's plight; or they value the practical over the theoretical and so consider beginning teachers as 'wet behind the ears' (White, 2005, p. 13).

Hargreaves (cited in White, 2005), argued that beginning teachers, at best, experience indifference or neglect from their more experienced colleagues but, at worst, they have to prove themselves by "overcoming the trials of fire that it is felt all new recruits should endure" (p. 5). Conversely, Newberry's (1978) research found that a barrier existed between beginning and experienced teachers but attributed it to the behaviours of both parties. She found that beginning teachers were as hesitant to ask for assistance as experienced teachers were to offer it. The novice was motivated by a fear of being perceived as incompetent and the experienced teacher by a fear of being seen as interfering.

Some of the programs designed to overcome these difficulties and support the beginning teacher within NSW government schools offer induction, orientation, mentoring, collegial support and access to on-line learning communities (NSW Department of Education and Training, 2006). However, these do not ensure consistent support for all beginning teachers across all educations systems and schools (McCormack & Thomas, 2003; Ramsey, 2000; Rossmanith, 2006).

Differences between teachers' ideals and the reality of teaching have been recorded as a contributing factor to the reality shock experienced in the first months of teaching (Hebert & Worthy, 2001; Huberman, 1989; Ryan, 1970). Weinstein (1990) found that beginning teachers often have an "unrealistic optimism" (p. 280) about their future teaching performance. He hypothesised that this is based on a vision of teaching which emphasises the affective dimensions of teaching such as caring, understanding, patience and the ability to relate to youngsters, attributes they feel they have prior to entering teacher education courses. This confidence leads them to feel secure about their future success and contributes to their sense of bewilderment when they experience the realities of teaching. Teaching presents beginning teachers with a persistent contradiction between "*what it is* and *what it should be*" (Flores & Day, 2006, p. 228).

However, a disparity between teachers' ideals and the reality of teaching is not simply a part of the reality shock or the survival stage of teacher development. Flores and Day's (2006) study identified a permanent struggle between beginning teachers' practices and their understanding of their job, which led them to teach in ways contrary to their teaching ideals. Rubalcava (2005) theorised that this dilemma often accounts for teachers leaving the profession. She suggested that the politics underpinning the bureaucracy of schools is at odds with “teachers who keep students’ humanity in mind [and] bring creativity and personal meaning to learning” (p. 71). As a result these teachers have difficulty working within the parameters imposed on them while moving toward fulfilling their goals as teachers.

Active or traditional learning

Beginning teachers are often caught between the beliefs and values regarding good mathematics teaching, acquired through their university preparation, and the norms and values of the contexts in which they teach (Hart, 2004). Flores and Day (2006) found that teachers felt "inner and practical tensions" (p. 224) between the pedagogical theories learned at university, with their emphasis on constructivism and meeting the needs of individual students, with the complex and demanding reality of teaching.

The effects of university courses are open to debate (Borko et al., 1992; Cook et al., 2002; Zeichner & Tabachnick, 1981) with their influence being alternatively represented as “liberal, conservative or non-existent” (Zeichner & Tabachnick, 1981, p. 10). However, it is commonly accepted that many beginning teachers, like their more experienced colleagues, implement traditional teaching methodologies rather than pedagogy consistent with active learning theories (Lortie, 1975; NSW Ministerial Advisory Council on the Quality of Teaching, 1999; O'Loughlin, 1989; Wells, 1984). The literature investigating beginning teachers’ efforts to implement practices consistent with active learning theories yields mixed results.

In their case study of a teacher undertaking an internship program in her final year of teacher preparation and moving into her first year of teaching, Smith and Lowrie (2001) noted the difficulties she had in implementing practices consistent with her “reform-oriented” (p. 31) beliefs about teaching mathematics. These originated with the external constraints placed upon her teaching, without her input and not open to negotiation, of compulsory textbooks and enforced ability groupings of students in mathematics lessons.

The participant in this study modified her teaching to accommodate these requirements but was confident enough in her beliefs to persevere with her efforts. The researchers questioned whether less confident beginning teachers would have coped with these constraints.

Gee and Gabel (1996) studied four elementary school teachers in their first year of teaching in an effort to evaluate the effectiveness of a teacher preparation program focusing on science. None of the teachers in this study used innovative teaching strategies and only one showed any evidence of the notion of 'science as inquiry' in their lessons, although they all supported this notion in interview. The researchers found that these novice teachers were not reflecting on their teaching practices but simply surviving. Issues such as time constraints, classroom management and problems with the school environment were thought to be contributing factors to their pedagogical choices.

Sparrow (2000) reported similar difficulties in his study of four novice primary school teachers in their mathematics teaching. These beginning teachers did not have time, in their normal hectic schedule, to be reflective practitioners. Survival issues were obstacles to them implementing pedagogy consistent with active learning theories. To some degree these difficulties were alleviated by the implementation of Sparrow’s personal and context-specific support model, which assisted the neophytes to move past survival and teach in ways consistent with current trends in mathematics education (Sparrow & Frid, 2001a, 2001b, 2002; Sparrow, 2000).

First-person inquiry

While most inquiry into teaching is undertaken from an outsider’s perspective, several studies report investigations “from the inside” (Ball, 2000) where the teacher is also the principal researcher. In contrast to other investigations, which deliberately divide teaching practice from teaching research, this type of inquiry seeks to blend “the construction of practice with its analysis” (Ball, 2000, p. 366). This is done in the hope of offering “special possibilities of insight and understanding, viewed through the firsthand experience of the teacher" (Ball, 2000).

These studies have focused on a range of issues including:

- teacher planning (Bisplinghoff, 2001);
- the effects of a teacher's shifting awareness of her own multiple cultural identities on her attempts to teach her culturally and socio-economically diverse 4th Grade (Gopalakrishnan, 2001);
- a teacher's shift from an individual constructivist perspective to a social constructivist perspective and its affect on his middle school philosophy class (Pardales, 2001);
- a teacher's reflections on the 'bumpy moments' she experiences in her classroom (Romano, 1995);
- a teacher's attempts to look at her own gender biases in her 4th Grade class and identify her motivations and a way forward (Pang-Maganaris, 1997);
- and an experienced teacher's autobiography of his experiences as a male elementary school teacher (Penny, 2000).

Several of these studies have focused on experienced teachers' attempts to implement pedagogy consistent with current recommendations for best practice in mathematics education (Ball, 1993b, 2000; Chazan, 1992; Heaton, 1994, 1995, 2000; Lampert, 1986, 1990, 1995, 2000; Simon & Tzur, 1999):

- Lampert (1986), using her own teaching as a site for research into student learning, was the first researcher-teacher to have her work published in a scholarly journal in the United States (Ball, 2000). This work predated the introduction of the NCTM *Standards* (NCTM, 1989, 1991) and contributed to the development of a vision of what teaching mathematics for understanding might look like (Ball, 2000). She approaches her work from three different perspectives: a teacher, a teacher educator, and a scholar (1998), challenging the teacher/researcher/policymaker relationship (Olson, 1990) where "the image is one of insiders who do

- Chazan (1992) reported his struggles with developing his own deep understanding of algebra in his efforts to implement the *NCTM Professional Standards for Teaching Mathematics* (1991).
- As a teacher educator Simon (1995) focused on the gap between theories of learning and theories of instruction. He studied his own teaching of a mathematics teaching and learning unit and developed a model of teacher decision-making that was grounded in a constructivist perspective.
- Ball (2000) has used her own practice as a site for research throughout her career. Her approach to this has included:
    - A detailed description and analysis of her own classroom, her teaching, and the children's work in her PhD dissertation, but presenting it with no reference to herself as the teacher (Ball, 1988a).
    - Supporting her formal research with the use of scenarios from her own teaching (Ball, 1989).
    - Using her classroom and experiences as a teacher to focus on the difficulties in teaching mathematics for understanding, by looking at specific lessons concentrating on particular mathematics content (Ball, 1993a, 1993b).
- In seeking to change her mathematics teaching from "good traditional teaching to teaching in the spirit of the reforms" (Ball, 2000, p. 382), Ruth Heaton focused on teacher learning in the context of teaching. She developed a methodological strategy of using different voices to communicate her different roles and relationships over the period of her study (Heaton, 1994). Her study not only offers insights into what it takes to handle the challenges of trying to remake herself as a teacher of elementary school mathematics, it also gives insights into what it is *like* to face these changes (Ball, 2000, p. 382).

First-person inquiry and beginning teachers

There are a few autobiographical accounts of beginning teachers (Atkins, 1972; Humphrey, 2000, 2002, 2003). Atkins (1972) wrote her account of the difficulties she experienced teaching mathematics to 4-6 year-olds in her first year. Her recount is not research-based but reflective on her insecurities in both her knowledge of mathematics and mathematics pedagogy. She felt unprepared to make many of the decisions necessary in her day-to-day teaching and asked if other teachers had similar experiences.

Humphrey (2000; 2002; 2003) has written several autobiographical articles, which have been compiled into a book, sharing her experiences of the first three years of teaching English to Years 7 and 8. These are reflections on her feelings, experiences and thoughts as a teacher of writing. She wanted to reflect on her life in the same way she encourages her students to reflect on theirs. Rather than analyse her experiences she wanted to encourage others, in their first years of teaching, to persevere. Her reflections explore her difficulties in coming to terms with falling short of her ideals. She talked about survival in terms of being exhausted and overwhelmed and listed patterns and habits she developed to give her structure and a sense of some 'control'. At the end of the first year she described herself as neither a good nor a bad teacher but as a 'real' teacher.

At the end of her third year she summarised her first three years: in her first year she mastered organisational skills; the second year she designed and implemented more creative units of work and made some headway with difficult children, she also took on extra school duties; in her third year she faced some extremely challenging circumstances both personally and professionally. She implemented new lessons and practices and felt confident in some of the things she taught. She concluded that while teaching is "frustrating, depressing, infuriating and tiring" there are times when it is "inspiring, uplifting, reassuring and refreshing" (Humphrey, 2002, p. 2). She acknowledged that even when she feels confident in her teaching something will happen to challenge her again.

While two teacher-researchers have reported on their investigations on themselves as novice teacher educators (Klein, 1996, 1997; McFadyen, 2000), for this thesis only one research article, written by a beginning teacher using first-person inquiry, could be located. In this project Anguiano (2001) made efforts to address misbehaviours in her third grade classroom. Identifying target behaviours, implementing research-based intervention techniques and recording the results of her efforts in behaviour charts, pre- and post-class surveys and journal entries, she achieved positive behavioural change in her classroom.

Summary

In reviewing the literature on beginning teachers a wide range of issues have been addressed in this chapter including: the process of becoming a teacher and the factors influencing this process; the stages of a teacher's development; the issues and problems commonly experienced by the beginning teacher; and the difficulties experienced by both experienced and beginning teachers in trying to implement pedagogy consistent with reform. It was established that first-person inquiry as a method of researching the lived experience of teaching has provided valuable insights into the process of teaching. While this type of research has been utilised to examine the experiences of practised teachers in their efforts to implement quality mathematics teaching, the experiences of beginning teachers have not been investigated from this perspective.

The previous chapter identified components of effective mathematics teaching, aligning them with the generic elements of quality teaching as detailed in the NSW model of pedagogy (NSW Department of Education and Training, 2003e) and detailing their appropriate use in providing high quality learning experiences in mathematics. It is against the backdrop of the quality teaching movement and the efforts to reform mathematics education that this research investigates the experiences of a beginning primary school teacher's efforts to implement components of best practice in mathematics teaching from a first-person inquiry perspective.

Focus of this research

This self-study inquiry has been undertaken in an effort to offer insights into the challenges of trying to teach mathematics in ways consistent with the current mathematics research literature as a beginning teacher and to give insights into what it is *like* to attempt teaching mathematics for understanding, utilising reform-oriented teaching practices, as a beginning primary school teacher.

As a PhD student and a novice teacher with a particular interest in primary school mathematics, I was in the unusual position of being able to use my own teaching as a site for investigating the experiences of a beginning teacher trying to teach mathematics for understanding, utilising reform-oriented pedagogy, from the 'inside'. I came to this research:

- as a novice teacher with no experience in teaching mathematics outside my professional experience placements;
- having confronted, challenged and changed my prior beliefs about mathematics and my conceptions of 'good' mathematics teaching;
- with a very clear theoretical knowledge of how children develop deep conceptual understandings of mathematics content and the pedagogy that best supports this type of learning;
- with some uncertainty, never having seen this type of practice in a primary school classroom, but having experienced the efforts of my university tutors to model this type of teaching pedagogy;
- with what I considered to be a solid procedural knowledge of primary school mathematics and hopeful that my mathematics background was sufficient to support my own conceptual understanding of all areas of primary school mathematics; and
- a commitment to developing my teaching of mathematics in line with best practice.

Research question

The focus, then, of this study is the lived experience of one beginning primary school teacher in her efforts to align her mathematics pedagogy with the recommendations made in the mathematics education literature. The research question has been designed to utilise the benefits of first-person inquiry, in giving an insight into this experience from the 'inside', without limiting the scope of this inquiry to any particular facet of this experience. It is aimed at providing insight, not only into the factors influencing the novice and the challenges faced as a beginning teacher in trying to teach mathematics for understanding, but to give an insight into what it is *like* for one beginning teacher, in trying to develop mathematics teaching strategies and skills consistent with reform, in the first years of teaching. The research question then is:

What are the influences, issues and challenges a beginning teacher experiences in trying to teach mathematics for understanding informed by current research and pedagogy?

CHAPTER FOUR

Methodology

Introduction

The principal goal of this study was to investigate from the 'inside' the experience of trying to implement reform-oriented pedagogy as a novice teacher, in my first two years of teaching mathematics. Methodological considerations were chosen to allow a rich exploration of the factors influencing myself as practitioner, in the decisions and choices made in my role as a primary school teacher in the mathematics KLA. Due to the nature of the inquiry and the complexities of teaching, these considerations changed over the period of study. The richness of this study is embodied in these changes which are, therefore, detailed in this chapter.

Methodological considerations

Being in the unusual position of a novice teacher while undertaking PhD studies provided an opportunity to explore, from the 'inside', the experience of trying to implement what is commonly accepted as 'best' teaching practice in primary school mathematics. Practitioner research, therefore, provided the overall methodological framework of this study.

While the origins of practitioner research have been attributed to the work in the 1940s of Kurt Lewin (Kember & Kelly, 1993; McKernan, 1996; Stringer, 1996; Zeichner & Noffke, 2001) and John Collier (McKernan, 1996; McNiff & Whitehead, 2002; Zeichner & Noffke, 2001) in their efforts to counteract racism and oppression, a number of curriculum study projects in the early 1920s evidenced many of the characteristics of practitioner research (Zeichner & Noffke, 2001). Factors that have been identified as influential in the adaptation of practitioner research as part of the study of educational problems include: the movement for the scientific study of education; the progressive educational philosophy of John Dewey; sociopolitical concerns for promoting democratic decision making; and the idea that social reconstruction can be linked to social research (Zeichner & Noffke, 2001).

The call for teachers to actively participate in research in cooperation with academics has a long history (Zeichner & Noffke, 2001). However, the notion that teachers could independently design and carry out inquiries into their own practice and that the results of these efforts could have meaning and value for others was not commonplace (Olson, 1990). Buckingham, in 1926, (cited in Olson, 1990) saw this as something that would lead to a greater professionalisation of teaching with the added benefit of raising the status of teaching. In the past, practitioner research has been seen as a useful form of professional development, less rigorous than other forms of research and not a legitimate form of educational research (Zeichner & Noffke, 2001). However, the notion that teachers are merely consumers of educational research has undergone a change and teachers can now be seen as “producers and mediators of knowledge” (Richardson cited in Zeichner & Noffke, 2001, p. 299).

There are multiple traditions of practitioner research, five of which are outlined by Zeichner and Noffke (2001):

1. Action research is based on the work of Collier and Lewin. It was introduced into schools in the United States by Stephen Corey in the 1950s. It was used to address problems of curriculum, instruction and supervision, either individually or in a group.
2. The teacher-as-researcher movement in the United Kingdom emerged in the 1960s in the context of ‘bottom-up’ school-based curriculum development initiated by Stenhouse, Elliott and others. Through the work of Stephen Kemmis, together with Wilfred Carr, it was brought to Australia and developed into an emancipatory model of action research known as Participatory Action Research.
3. The North American teacher research movement emerged in the 1980s. It reflects a growing acceptance of qualitative and case-study research and the use of action research in university teacher education programs.

4. The tradition of self-study research has emerged from college and university faculty members conducting research on their own practice. It has used various qualitative methodologies and focused on a wide range of issues.
5. The tradition of participatory research has largely developed in Third World countries. It is closely associated with adult education and literacy, although wider social issues and problems have also been addressed. Its explicit aim is to bring about a just and humane society.

The tradition of self-study research (Option 4), involving university and college staff using their own practice as a site for investigation, is the primary form of practitioner research used in this study. Within this context it was envisaged that using individual action research (Option 1), data would be collected through the process of: identifying problems, issues or constraints arising in the planning and implementation of the mathematics program; investigating possible solutions; and determining and implementing plans of action.

Anderson, Herr and Nihlen (2007) maintained that practitioner research in this form follows the lead of Schön (1983) "in attempting to understand how practitioners learn their craft" (Anderson et al., 2007, p. 31). This type of research requires researchers to balance the demands of 'data gathering' and 'self-reflection', directing their attention both inwardly and outwardly in their attempts to understand and improve their practice (Anderson et al., 2007). Kincheloe (cited in Anderson et al., 2007) argued that critical reflection is vital in elevating this type of research beyond a trivial enterprise focused on improving the skills of one practitioner using a "cookbook" style approach (p. 33) to an endeavour with a vision for educational transformation and challenge.

These research methods are within the parameters of a phenomenological study incorporating first-person inquiry methods similar to that used in the work of Ball (1993b; 2000), Chazan (1992), Lampert (1986; 1990; 1995; 2000), Heaton (1994; 1995; 2000), Chambers (2002) and Simon and Tzur

(1999), where the phenomenon studied is experienced from the 'inside' (Ball, 2000). Unlike other phenomenological research, the researcher/participant is also involved in constructing the phenomenon to be studied, offering the opportunity to study what it takes "to enact a certain kind of teaching, classroom, or curriculum" (Ball, 2000, p. 388). It also provides the opportunity to "access, uncover, and probe elements of the situation or experience invisible to the outsider. What is it like to do this sort of teaching? What tensions arise? What are the feelings entailed? What are the incentives? What is the underlying reasoning?" (Ball, 2000, p. 388).

Action research is also informed by phenomenology (Stringer, 2004), a methodological framework which seeks to describe the meaning of the 'lived experiences' of people in everyday life (Creswell, 1998; Giorgi & Giorgi, 2003; Hughes, 1990). Phenomenological studies seek to examine people's firsthand experiences through their own descriptions, thus capturing the way in which the phenomenon is experienced within the context in which it takes place (Giorgi & Giorgi, 2003). Action research always incorporates the goals of improvement and involvement for its participants (Grundy, 1982; Kember & Kelly, 1993). It was envisaged that being involved both as a researcher and participant, cycles of action research would not only highlight the factors that influence my own teaching practices, they would help me to improve my teaching.

An investigation of this kind focuses on teacher thinking, actions and feelings, seeking to capture the complexities of learning to teach mathematics for understanding utilising reform-oriented pedagogy from the perspective of a novice teacher. Within this context qualitative methods were considered the most appropriate way to encapsulate the experience of becoming a teacher of primary school mathematics. It is an interpretive approach which uses techniques that are sensitive to context and seeks to understand the perspective of the person living the experience (Denzin & Lincoln, 2005; Neuman, 2003). As opposed to quantitative or positivist inquiry methods which seek to test laws of human behaviour, qualitative research is concerned with achieving empathic understanding (Neuman, 2003). It deals with the interpretation of texts produced by recording and transcribing (Flick, 2006).

Within this context the data collection phase of the study commenced in 2002 and continued throughout 2003.

Procedure

Intended procedure

In 2002 I undertook part-time work, teaching primary school mathematics to a group of Year 2 students. The teaching was undertaken at an independent school for one hour, four days per week. In the course of the year the size of the class fluctuated, due to student movement in and out of the school, being twenty-two or twenty-three students at any time. As the group’s mathematics teacher, I was totally responsible for the mathematics programming, planning, teaching, assessment and reporting, with the exception of the administration of a page from a mental arithmetic textbook each Friday. This work constituted the only specified mathematics on that day and was undertaken by the students’ regular classroom teachers.

The group of students were the middle-ability group of the Year 2 cohort. The grouping was determined by the students’ results in Year 1, with adjustments made in the first six weeks of Term 1 based on the class teachers’ assessments of students’ progress within their group. Initially the Year 2 cohort consisted of fifty-six students and was divided into three groups; twenty-two in the top ability group, twenty-two in the middle ability group and twelve in the lower ability group. The top and lower groups were taught by the regular Year 2 classroom teachers.

It was anticipated that throughout the two years of the study a reflective approach would be undertaken, where each term an aspect of my mathematics pedagogy would be identified as needing to improve. This would be determined by assessing the greatest need in my mathematics lessons, in terms of supporting the students’ conceptual understanding of mathematics and providing a positive learning environment. A plan of action to address this need would be determined and implemented throughout the term. Details of the attempts to implement the component of effective mathematics pedagogy, and my associated reflections, would be recorded. This was undertaken in 2002 and the action research cycles I completed are reported in Table 6 (p. 110).

Table 6 2002 action research cycles

Date	Research Cycle	Data collection methods
End of Term 1, 2002	**Cycle 1**:	
	1. Reflecting and identifying problem – ***textbook focus***	Diary, program and evaluation notes
	2. Action plan devised ***– to introduce non-routine problem solving as a regular part of teaching program***	Program included non-routine problems
Term 2, 2002	**3.** Implementation of plan - ***introduction of non-routine problem solving as part of teaching program***	Dairy, program and evaluation notes; 2 videotaped lessons and notes
End of Term 2, 2002	Cycle 2:	
	1. Reflecting and identifying problem – ***lack of discussion and closure to lesson***	Diary, program and evaluation notes
	2. Action plan devised – ***to program for shorter lessons allowing closure time and establishing discussion as a regular part of lessons***	Diary, program and evaluation notes
Term 3, 2002	**3.** Implementation of plan – ***shorter activity time introduced and discussion a regular closure activity***	Diary, program and evaluation notes; videotaped lesson and notes

End of Term 3 2002	**Cycle 3:**	
	1. Reflecting and identifying problem – ***better management of assessment and reporting***	Diary, program and evaluation notes
	2. Action plan devised – *plan for assessment tasks; be more diligent in assessing understanding lesson by lesson*	Diary
Term 4, 2002	***3.*** Implementation of plan – *assessment outcomes and coding established and used*	Diary, program and evaluation notes
Term 4 holidays	**4.** Reflection *on assessment and reporting*	Diary, program and evaluation notes

Procedural changes

By Term 3 of 2002 it became obvious that my own experiences were not in keeping with the experiences of other novice teachers with whom I was in contact. These novice teachers were teaching across all KLAs, usually on a full-time basis, which added complexities to their experiences which I was not experiencing in teaching only mathematics on a part-time basis. Therefore, the decision was made to seek a full-time classroom teaching position in 2003. A full-time maternity leave position was secured which commenced in Week 8 of Term 4, 2002 and continued throughout 2003. Therefore, in the last four weeks of Term 4, 2002 I taught a Year 2 class consisting of 28 children, 11 of whom I had taught previously in my mathematics group, the other 17 being unfamiliar.

In 2003 I undertook a full-time classroom teaching position with a Year 4 class at the same independent school. The school policy was to divide the primary cohorts into ability levels for Mathematics and English and accelerate students, where necessary, to higher grades. I taught the top ability group for Mathematics which consisted of 32 students (29 Year 4 students and three Year 3 students). The Year 4 students were drawn from both Year 4 classes.

In 2003 I began teaching with the intention of following a similar pattern to the previous year. Each term I would identify the greatest area of need in my mathematics pedagogy, as it impacted on the quality of my mathematics lessons and the development of my students' conceptual understanding of mathematics. I would determine a plan of action to improve this area of need and implement this plan. However, the impact of having the full responsibilities of a class and teaching the whole of the curriculum led to the conclusion that I could, at best, concentrate on becoming confident with the Year 4 content and associated student thinking, for the remainder of the year. Efforts to implement quality teaching practices would be my general intention, rather than focusing on improving particular aspects of my pedagogy. Therefore, my approach to improving my practice in line with the mathematics education literature no longer involved action research methodologies.

In summary, in 2002 I reflected on my teaching, then planned and implemented 'strategic action' which Grundy (1982) described as "deliberate, considered action undertaken to bring about change" (p. 353). In moving to a full-time classroom position in 2003 it became clear very quickly that the responsibilities of a classroom teacher would, by necessity, impact the research in terms of data collection and focus. The contrast between my experiences in trying to implement pedagogy consistent with mathematics education reform in my first part-time year of teaching only mathematics, and the second year of teaching full-time as a classroom teacher, was striking. My reflections now included the impact of my workload across all KLAs and the complexities of the relationships in the classroom and wider school community. What began as deliberate, considered action undertaken to bring about change became ad hoc, survival strategies to implement the curriculum without succumbing to burn-out.

Contextual disparity

In making these procedural changes, moving from teaching mathematics only on a part-time basis in 2002 to teaching all KLAs as a full-time teacher in

2003, a disparity of contexts was unintentionally established. These differing contexts unexpectedly provided insights into issues involved in teaching mathematics for conceptual understanding, as a beginning teacher, that might otherwise have been overlooked. This change in research design afforded the opportunity to distinguish to some degree between:

- the challenges and issues presented by the unfamiliar nature of constructivist pedagogy, enabled by the part-time workload in the first year of teaching; and
- the challenges and issues presented in beginning to teach in the second, full-time year of teaching.

Creswell argued that qualitative research is "emergent rather than tightly prefigured" with several aspects emerging throughout the study, including changes in data collection processes "as doors open and close" (1998, p. 181). Punch and O'Donoghue (2003) maintained that value can be added to a project through the unexpected turns qualitative research can take, moving through different theoretical methodological positions and often ending up significantly removed from the original premise. This reflects my experience in the course of this project.

Research and analysis techniques

In this section a description and justification of the methods used for data collection and analysis is given. Methods of data collection included:

- Program and evaluation notes
- Day Planner notes
- Reflective diary
- Organisational diary
- Video-taped lessons throughout the period of the study

Program and evaluation notes, day planner entries and an organisational diary were kept as a regular part of my teaching practice, although the entries for program and lesson evaluations were more detailed than had previously been kept. The reflective diary was kept specifically for the purposes of data collection over the two years of the study. It was anticipated that the video-taping of lessons would occur once a term with a view to evaluating my efforts to implement reform-oriented teaching practices in the light of the action research cycles undertaken. In practice, three lessons were taped each year of the study due largely to: the demands of assessment in the final term of 2002, complicated by a move from part-time to full-time teaching, and; the overwhelming workload associated with teaching full-time in 2003. Notes were taken to record my responses to the teaching experiences and to give some insight into moment-by-moment thinking that informed my teaching behaviours. The sample of lessons was planned for on the basis of convenience, occurring at times that were most suitable in terms of workload and the availability of assistance for the operation of the recording equipment.

Following the video-taping of each lesson, video-tapes were reviewed and reflective notes were taken. Analysis of the transcripts of diaries, programs and video-taped lesson notes, was undertaken using the NVivo 2 computer program (QSR, 2002) at the conclusion of the data collection process. The video-taped lessons were subsequently analysed in terms of both the NSW model of pedagogy and review of the mathematics education literature using two instruments:

- The coding scale overview of the 18 elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) (Tables 7, 8, 9, pp. 115-117); and
- The coding guidelines developed to analyse the components of effective mathematics teaching, identified in the mathematics education research literature, within a framework of effective mathematics teaching based on the work of D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997) (Tables 10, 11, 12, pp. 118-122).

Table 7 Coding scale overview D1: Intellectual quality

Coding Scale Overview for Dimension 1: Intellectual Quality					
Deep knowledge	1 Almost all of the content knowledge of the lesson is shallow because it does not deal with significant concepts or ideas.	2 Some key concepts and ideas are mentioned or covered by the teacher or students, but only at a superficial level.	3 Knowledge is treated unevenly during instruction. A significant idea may be addressed as part of the lesson, but in general the focus on key concepts and ideas is not sustained throughout the lesson.	4 Most of the content knowledge of the lesson is deep. Sustained focus on central concepts or ideas is occasionally interrupted by superficial or unrelated ideas or concepts.	5 Knowledge is deep because focus is sustained on key ideas or concepts throughout the lesson.
Deep understanding	1 Students demonstrate only shallow understanding.	2 For most students, understanding is shallow during most of the lesson, with one or two minor exceptions.	3 Deep understanding is uneven. Students, demonstrate both shallow and deeper understanding at different points in the lesson. A central concept understood by some students may not be understood by other students.	4 Most students provide information, arguments or reasoning that demonstrates deep understanding for a substantial portion of the lesson.	5 Almost all students demonstrate deep understanding throughout the lesson.
Higher-order thinking	1 Students demonstrate only lower-order thinking. They either receive or recite pre-specified knowledge or participate in routine practice, and in no activities during the lesson do students go beyond simple reproduction of knowledge.	2 Students primarily demonstrate lower-order thinking, but at some point, at least some students perform higher-order thinking as a minor diversion within the lesson.	3 Students primarily demonstrate routine lower-order thinking a good share of the lesson. There is at least one significant question or activity in which most students perform some higher-order thinking.	4 Most students demonstrate higher-order thinking in at least one major activity that occupies a substantial portion of the lesson.	5 All students, almost all of the time, demonstrate higher-order thinking.
Problematic knowledge	1 All knowledge is presented only as fact and not open to question.	2 Some knowledge is treated as open to multiple perspectives.	3 Knowledge is treated as open to multiple perspectives, seen as socially constructed and therefore open to question.	4 Knowledge is seen as socially constructed and multiple perspectives are not only presented, but are explored through questioning of their basic assumptions.	5 Knowledge is seen as socially constructed, with multiple and/or conflicting interpretations presented and explored to an extent that a judgement is made about the appropriateness of an interpretation in a given context.
Metalanguage	1 No metalanguage. The lesson proceeds without the teacher or students stopping to comment on the language being used.	2 Low metalanguage. During the lesson terminology is explained or either the teacher or students stop to make value judgements or comment on language. There is, however, no clarification or assistance provided regarding the language.	3 Some use of metalanguage. At the beginning of the lesson, or at some key juncture, the teacher or students stop and explain or conduct a "mini-lesson" on some aspect of language, e.g. genre, vocabulary, signs or symbols.	4 Periodic use of metalanguage. The teacher or students provide commentary on aspects of language at several points during the lesson.	5 High use of metalanguage. The lesson proceeds with frequent commentary on language use.
Substantive communication	1 Almost no substantive communication occurs during the lesson.	2 Substantive communication among students and/or between teacher and students occurs briefly.	3 Substantive communication among students and/or between teacher and students occurs occasionally and involves at least two sustained interactions.	4 Substantive communication, with sustained interactions, occurs over approximately half the lesson with teacher and/or students scaffolding the conversation.	5 Substantive communication, with sustained interactions, occurs throughout the lesson, with teachers and/or students scaffolding the communication.

Table 8 Coding Scale Overview for D2: Quality Learning Environment

Coding Scale Overview for Dimension 2: Quality Learning Environment					
Explicit quality criteria	1 No explicit statements regarding the quality of work are made. Only technical and procedural criteria are made explicit.	2 Only general statements are made regarding the desired quality of the work.	3 Detailed criteria regarding the quality of work are made explicit during the lesson, but there is no evidence that students are using the criteria to examine the quality of their work.	4 Detailed criteria regarding the quality of work are made explicit or reinforced during the lesson and there is evidence of some students, some of the time, examining the quality of their work in relation to these criteria.	5 Detailed criteria regarding the quality of work are made explicit or reinforced throughout the lesson and there is consistent evidence of students examining the quality of their work in relation to these criteria.
Engagement	1 Low engagement or disengagement. Students are frequently off-task, perhaps disruptive, as evidenced by inattentiveness or serious disruptions by many. This is the central characteristic during much of the lesson.	2 Sporadic engagement. Most students, most of the time, either appear apathetic and indifferent or are only occasionally active in carrying out assigned activities. Some students might be clearly off-task.	3 Variable engagement. Most students are seriously engaged in parts of the lesson, but may appear indifferent during other parts and very few students are clearly off-task.	4 Widespread engagement. Most students, most of the time, are on-task pursuing the substance of the lesson. Most students seem to be taking the work seriously and trying hard.	5 Serious engagement. All students are deeply involved, almost all of the time, in pursuing the substance of the lesson.
High expectations	1 No students, or only a few, participate in any challenging work.	2 Some students participate in challenging work during at least some of the lesson. They are encouraged (explicitly or through lesson processes) to try hard and to take risks and are recognised for doing so.	3 Many students participate in challenging work during at least half of the lesson. They are encouraged (explicitly or through lesson processes) to try hard and to take risks and are recognised for doing so.	4 Most students participate in challenging work during most of the lesson. They are encouraged (explicitly or through lesson processes) to try hard and to take risks and are recognised for doing so.	5 All students participate in challenging work throughout the lesson. They are encouraged (explicitly or through lesson processes) to try hard and to take risks and are recognised for doing so.
Social support	1 Social support is low. Actions or comments by the teacher or students result in "put-downs", and the classroom atmosphere is negative.	2 Social support is mixed. Both undermining and supportive behaviours or comments are observed.	3 Social support is neutral or mildly positive. While no undermining behaviours are observed, supportive behaviours or comments are directed at those students most engaged in the lesson, rather than those students who are more reluctant.	4 Social support is clearly positive. Supportive behaviours and comments are directed at most students, including clear attempts at supporting reluctant students.	5 Social support is strong. Supportive behaviours or comments from students and the teacher are directed at all students, including soliciting and valuing the contributions of all.
Students' self-regulation	1 Few students demonstrate autonomy and initiative in regulating their own behaviour. The teacher devotes more time to disciplining and regulating student behaviour than to teaching and learning.	2 Some students demonstrate autonomy and initiative in regulating their own behaviour, but there is still substantial interruption to the lesson for disciplinary and/or regulatory matters, as an attempt to avert poor behaviour, correct past behaviour or as an immediate reaction to poor student behaviour.	3 Many students demonstrate autonomy and initiative in regulating their own behaviour and the lesson proceeds coherently. However, the teacher regulates behaviour several times, making statements about behaviour to the whole class, or perhaps focusing on students who are acting inappropriately.	4 Most students, most of the time, demonstrate autonomy and initiative in regulating their own behaviour and there is very little interruption to the lesson. Once or twice during the lesson, the teacher comments on or corrects student behaviour or movement.	5 All students, almost all of time, demonstrate autonomy and initiative in regulating their own behaviour and the lesson proceeds without interruption.
Student direction	1 No evidence of student direction. All aspects of the lesson are explicitly designated by the teacher for students.	2 Low student direction. Although students exercise some control over some aspect of the lesson (choice, time, pace, assessment), their control is minimal or trivial.	3 Some student direction. Students exercise some control in relation to some significant aspects of the lesson.	4 Substantial student direction. Some deliberation or negotiation occurs between teacher and students over at least some significant aspects of the lesson.	5 High student direction. Students determine many significant aspects of the lesson either independent of, or dependent on, teacher approval.

Table 9 Coding Scale Overview for D3: Significance

Coding Scale Overview for Dimension 3: Significance					
Background knowledge	1 Students' background knowledge is not mentioned or elicited.	2 Students' background knowledge is mentioned or elicited, but is trivial and not connected to the substance of the lesson.	3 Students' background knowledge is mentioned or elicited briefly, is connected to the substance of the lesson, and there is at least some connection to out- of-school background knowledge.	4 Students' background knowledge is mentioned or elicited several times, is connected to the substance of the lesson, and there is at least some connection to out-of-school background knowledge.	5 Students' background knowledge is consistently incorporated into the lesson, and there is substantial connection to out-of-school background knowledge.
Cultural knowledge	1 No explicit recognition or valuing of other than the knowledge of the dominant culture is evident in the substance of the lesson.	2 Some cultural knowledge is evident in the lesson, but it is treated in a superficial manner.	3 Some cultural knowledge is recognised and valued in the lesson, but within the framework of the dominant culture.	4 Substantial cultural knowledge is recognised and valued in the lesson with some challenge to the framework of the dominant culture.	5 Substantial cultural knowledge is recognised and valued throughout the lesson and this knowledge is accepted as equal to the dominant culture.
Knowledge integration	1 No meaningful connections. All knowledge is strictly restricted to that explicitly defined within a single topic or subject area.	2 Some minor or trivial connections are made. Knowledge is mostly restricted to that of a specific topic or subject area.	3 At least one meaningful connection is made between topics or subject areas by the teacher and/or the students during the lesson.	4 Several meaningful connections are made between topics or subject areas by the teacher and/or the students during the lesson.	5 Meaningful connections are regularly made between topics or subject areas by the teacher and/or the students during the lesson.
Inclusivity	1 Some students are excluded, or exclude themselves, from lesson activities throughout the lesson.	2 Some students are excluded, or exclude themselves, from the majority of lesson activities except for minor forms of inclusion in one or two instances during a lesson.	3 Students from all groups are included in most aspects of the lesson, but the inclusion of students from some groups may be minor or trivial relative to other groups.	4 Students from all groups are included in a significant way in most aspects of the lesson, but there still appears to be some unevenness in the inclusion of different social groups.	5 Students from all groups are included in all aspects of the lesson and their inclusion is both significant and equivalent to the inclusion of students from other social groups.
Connectedness	1 The lesson has no clear connection to anything beyond itself. Neither the teacher nor the students offer any justification for the lesson beyond the school.	2 The teacher or students try to connect what is being learned to the world beyond the classroom, but the connection is weak and superficial or trivial.	3 Students recognise some connection between classroom knowledge and situations outside the classroom, which might include sharing their work with an audience outside the classroom, but they do not explore implications of these connections which remain largely abstract or hypothetical.	4 Students recognise and explore connections between classroom knowledge and situations outside the classroom in ways that create personal meaning and highlight the significance of the knowledge. There might be an effort to influence an audience beyond the classroom.	5 Students recognise and explore connections between classroom knowledge and situations outside the classroom in ways that create personal meaning and highlight the significance of the knowledge. This meaning and significance is strong enough to lead students to become involved in an effort to influence an audience beyond the classroom.
Narrative	1 Either narrative is used at no point in the lesson, or the narratives used are disconnected or detract from the substance of the lesson.	2 Narrative is used on occasion as a minor part of the lesson and/or is loosely connected to the substance of the lesson.	3 Narrative is used at several points in the lesson to enhance the significance of the substance of the lesson.	4 Narrative is used for a substantial portion of the lesson to enhance the significance of the substance of the lesson.	5 Narrative is used throughout the lesson to enhance the significance of the substance of the lesson.

Table 10 Coding guidelines of D1 - effective mathematics teaching

Coding guidelines for Dimension 1 – Intellectual quality- in terms of components of effective mathematics teaching					
	1	2	3	4	5
Content	The content of the lesson does not deal with significant concepts or ideas as identified in the Syllabus	Some key concepts or ideas as identified in the Syllabus are mentioned, but only superficially.	While key ideas and concepts from the Syllabus are addressed, a focus on them is not sustained throughout the lesson.	A sustained focus on key ideas and concepts from the Syllabus is occasionally interrupted by unrelated or superficial concepts.	Focus on key ideas and concepts from the Syllabus are sustained throughout the lesson.
	1	2	3	4	5
Explicit focus	The focus of the lesson is not clear either in the activities or as explained by the teacher.	The focus of the lesson is evident in the activities but the teacher has not explained the focus to the children.	The focus of the lesson is evident in the activities and the teacher has briefly referred to it in the lesson.	The focus of the lesson is evident in the activities and the teacher has referred to it several times in the lesson.	The focus of the lesson is evident in the activities and the teacher has explained it clearly and reiterated it throughout the lesson.
	1	2	3	4	5
Teaching for conceptual understanding	Lessons are based on learning facts, skills and procedures. They are acquired by imitation and reinforced by repeated practice.	A procedural approach to mathematics is evident for much of the lesson, with the use of word problems and/or manipulative materials to support an understanding of the procedures, skills and facts. Alternative student procedures and/or understandings are not supported or valued if they become evident.	A mix of approaches is evident in the lesson, with the use of word problems and/or manipulative materials to support an understanding of the procedures, skills and facts. However, alternative student procedures and/or understandings are supported if they become evident and there are occasions where activities are used to encourage conceptual thinking.	A greater mix of activities where some are structured to enable students to develop an understanding of the procedures, skills and facts and others are used to develop conceptual thinking and understanding and to support the development of students' procedures for solving problems. Formal algorithms are also taught alongside these activities, but students can use their own effective methods if they prefer.	A highly integrated mixing of approaches where most activities are structured to enable students to develop an understanding of the procedures, skills and facts; to develop conceptual thinking and understanding; and to support the development of students' procedures for solving problems. Formal algorithms are introduced where appropriate to support conceptual understanding, not provide a set procedure for all students.
	1	2	3	4	5
Problem solving	The whole focus of the lesson is the development of skills and procedures through imitation and practice.	'Hands-on' activities and/or 'real life' word problems are included as an introduction to a topic. Relevant skills and procedures are identified and further similar problems are solved through imitation and practice.	The process of solving meaningful and challenging problems which allow students to build on prior knowledge is a feature of the lesson but the development of skills and procedures through imitation and practice takes a significant portion of lesson time.	Meaningful and challenging problems which allow students to build on prior knowledge form the basis of the lesson. The recall of facts, the following of procedures and the development of skills is not the focus of the lesson. When activities are provided for this they are supported by students' prior understanding.	Meaningful and challenging problems which allow students to build on prior knowledge form the basis of the lesson. The recall of facts, the following of procedures and the development of skills is not the focus of the lesson. When activities are provided for this they are supported by students' prior understanding. Students are encouraged to think about their world, pose problems and/or extend investigations presented by the teacher.

Coding guidelines for Dimension 1 – Intellectual quality- in terms of components of effective mathematics teaching					
	1	2	3	4	5
Discussion	Discussion is dominated by the teacher. It involves explanations and demonstrations of correct procedures and answers. The focus is on getting the correct answer. Questions are closed and the teacher's response is a quick 'right' or 'wrong'.	Discussion is brief and includes the sharing of one or two students' solutions with the class. Feedback is from the teacher. The focus of these discussions is sometimes on students' thinking but usually focuses on the correct answers and/or procedures. Some students are attentive to other students but many students do not maintain attention in discussion times. Mistakes are always corrected by the teacher.	Discussion is brief and includes the sharing of one or two students' solutions with the class. Feedback is from the teacher. The focus of these discussions is sometimes on students' thinking but usually focuses on the correct answers and/or procedures. Some students are attentive to other students but many students do not maintain attention in discussion times. Mistakes are nearly always corrected by the teacher rather than used as opportunities for further investigation.	Demonstration, explanation and justification of solutions are a regular feature of lessons and all students are expected to respond attentively to these discussions. However, some struggling students do not often have that opportunity. Feedback is largely from the teacher but can include student responses. The focus of these discussions is often on students' thinking but can also focus only on correct answers. Many students, most of the time, are attentive to other students, though some students do not maintain attention in discussion times. Mistakes are usually corrected by the teacher rather than used as opportunities for further investigation.	It is a class expectation that any student may be asked to demonstrate, explain and justify their solutions and that all students respond attentively to these discussions. Most students, most of the time, participate in this way. Discussion is not dominated by the teacher or a few students. It includes feedback from other students as well as the teacher. The focus of these discussions is on students' thinking rather than correct answers. Mistakes are treated as opportunities for further investigation not failures.
	1	2	3	4	5
Written work	All written work is completing textbook examples or practising sets of examples in a workbook.	Most written work is completing textbook examples or practising sets of examples in a workbook. A mathematical activity is recorded in a workbook e.g. data collected and associated graph and conclusions.	A substantial amount of written work is completing textbook examples or practising sets of examples in a workbook. A mathematical activity is recorded in a workbook and students' workings in their solution attempts are shown.	Some written work is completing textbook examples or practising sets of examples in a workbook. The investigation attempts of a key concept are recorded in a workbook and/or journal and students' workings, opinions or thinking are recorded.	A substantial amount of the written work includes the recording of students' thinking about the ideas and concepts being encountered. It may include the solution attempts of an individual or small group where students show how they are solving a problem by writing or drawing. Drill and practice writing is not the main component of writing in the lesson.
	1	2	3	4	5
Student reflection	No meaningful discussion and/or written work provided to support student reflection.	Discussion is focused largely on correct answers but mention of student thinking is briefly referred to once or twice. And/or written work is mainly the completion of textbook or workbook examples, students are encouraged if they show the working out of a solution.	Discussion includes sharing of several student solutions, though the communication is brief. Feedback is mainly from the teacher and it includes several references to students' thinking. And/or while most of the written work involves completing textbook examples, students are required to show their working out of solutions.	The focus of discussion is student thinking. Most feedback comes from the teacher but a few students also give feedback. And/or while some written work involves completing textbook examples, the investigation of a key concept is supported by written work showing working out of solutions and/or recording of opinions and/or thinking.	The focus of discussion is student thinking. The discussion is not dominated by the teacher but includes substantial feedback from other students. And/or the investigation of key concepts is supported by written work showing working out of solutions and/or recording of opinions and/or thinking.

Table 11 Coding guidelines of D2 - effective mathematics teaching

Coding guidelines for Dimension 2 - Quality learning environment - in terms of components of effective mathematics teaching					
	Element 8 'Engagement' assessed many observable characteristics associated with the component 'Motivation' such as involvement, off-task behaviours, attentiveness and disruptive behaviours. This component then will assess ways the lesson is structured to support student motivation.				
Motivation	1 No variety in lesson activities and/or the problems students are given are uninteresting and/or unchallenging. The pace of the lesson is either too slow or too fast for most students.	2 Some variety in lesson activities which are mainly uninteresting and/or unchallenging. The pace of the lesson is inappropriate in a substantial part of the lesson.	3 There is an appropriate variety of lesson activities but some of these are not very interesting and/or challenging. The pace of the lesson is appropriate some of the time.	4 The variety of lesson activities is appropriate with several activities or problems being interesting and/or challenging. The pace of the lesson is appropriate most of the time.	5 The variety of lesson activities is appropriate with most of the activities and problems being interesting and/or challenging. The pace of the lesson is appropriate almost all of the time.
Mathematical resources	1 No (or inappropriate) mathematical resources available in the lesson.	2 Mathematical resources only used by the teacher to explain and/or demonstrate. Some students may be asked to assist in this.	3 Appropriate mathematical resources are available but not in sufficient quantities for all children to have ready access to them to conduct an investigation or solve a problem. OR If there are sufficient mathematical resources for all children only some students choose to use them some of the time to assist in solving problems and/or modelling solutions. Many students do not use them (or use them inappropriately) but not because they are confident or competent in their alternative approaches.	4 Appropriate and sufficient mathematical resources are available for an activity and many students choose to use them to solve problems and/or model solutions. Some students do not use them (or use them inappropriately) but not because they are confident or competent in their alternative approaches.	5 Most students use mathematical resources purposely to solve problems and/or model solutions (those that don't, choose to use more abstract approaches and are confident and competent in their attempts).
	High expectations of students in completing challenging work and trying hard are coded in Element 9 'High Expectations'. Therefore, the coding of this component only relates to the assessment of teacher's expectations regarding the standard of student behaviour in mathematics lessons that supports all students' learning in a safe learning environment.				
High expectations of behaviour.	1 Guidelines for acceptable classroom behaviour not evident at all and/or unacceptable behaviours are not dealt with consistently and/or appropriately.	2 Some guidelines for acceptable classroom behaviours are evident in some form but many students evidence unacceptable behaviour. Unacceptable behaviours are often not dealt with consistently and/or appropriately.	3 Some guidelines for acceptable classroom behaviour are communicated and evidenced in the behaviour of some students most of the time. Unacceptable behaviours are often dealt with consistently and/or appropriately.	4 Guidelines for acceptable classroom behaviour are communicated and evidenced in the behaviour of many students most of the time and unacceptable behaviours are usually dealt with consistently and/or appropriately.	5 Appropriate classroom behaviour is evidenced by most students most of the time and unacceptable behaviours are nearly always dealt with consistently and/or appropriately.
Risk taking	1 The classroom is stark and evaluative, focused on 'right' and 'wrong' answers and speedy completion of tasks. Students receive feedback only for correct or incorrect answers. Most students do not make contributions to discussions and/or share their answers voluntarily. Few students ask for help, ask or answer questions voluntarily. Rules regarding appropriate behaviour in mathematical activities and discussions are not evident.	2 The focus of the mathematics lesson is largely on 'right' and 'wrong' answers and speedy completion of tasks, although recognition is given for contributing to discussions and/or sharing answers even when incorrect. Some students ask for help when needed, ask or answer questions voluntarily. Rules regarding appropriate behaviour in mathematical activities and discussions are not consistently reinforced.	3 The focus of the mathematics lesson is often on 'right' and 'wrong' answers and speedy completion of tasks, although recognition is given for contributing to discussions and/or sharing answers even when incorrect. Many students ask for help when needed, ask or answer questions voluntarily. Students are sometimes recognised for academic risk taking. Rules regarding appropriate behaviour in mathematical activities and discussions are often reinforced.	4 The focus of the mathematics lesson is sometimes on 'right' and 'wrong' answers and speedy completion of tasks, but more often on learning and teamwork. Most students get actively involved in solving problems, ask for help when needed, ask and answer questions, and contribute to discussions. Students are often recognised for academic risk taking. Rules regarding appropriate behaviour in mathematical activities and discussions are usually evident.	5 The focus in the classroom is on learning and teamwork. All students are actively involved in solving problems, most of the time, ask for help when needed, ask and answer questions, and contribute to discussions. Students are regularly recognised for academic risk taking. Rules regarding appropriate behaviour in mathematical activities and discussions are nearly always evident.

Coding guidelines for Dimension 2 - Quality learning environment - in terms of components of effective mathematics teaching					
Social organisation	1 Most mathematics work is undertaken individually, sessions undertaken as a whole class for the teacher to explain/ demonstrate and mark work.	2 Students spend considerable time working by themselves and/or as a whole class responding to teacher explanation/ demonstration/ marking. One or two activities include group or pair work. Some students remain on task and try to cooperate with others. Most students work independently and/or uncooperatively in their group/pair and/or do not join in the joint activity or negotiate a solution.	3 A variety of groupings is utilised in the lesson. Some small groups or pairs work well together some of the time. Many students work independently in their group or do not join in the joint activity or negotiate a solution.	4 A variety of groupings is utilised in the lesson. Most small groups or pairs work well together some of the time. Most group members contribute to the activity and negotiate agreement on a solution.	5 A variety of groupings is utilised in the lesson. All small groups or pairs work well together most of the time, each member contributing to the activity and negotiating agreement on a solution.
Teacher's relationships	1 The classroom atmosphere is negative with 'put-downs' by teacher and/or students being unchecked.	2 Teacher has a neutral relationship with most students. No negative or positive behaviours or comments are observed.	3 Teacher has a positive relationship with many students. This is evidenced in supportive behaviours and comments usually to those most engaged in the lesson rather than those who are more reluctant.	4 Teacher has a positive relationship with most students. This is evidenced in supportive behaviours and comments, usually to those most engaged in the lesson, but also include clear attempts to support reluctant students.	5 Teacher has a positive relationship with all students. This is evidenced in supportive behaviours and comments, positive teacher/student interactions and student contributions and help seeking.
Student autonomy	1 The entire lesson consists of the teacher describing, explaining and demonstrating procedures for students to copy and practise, the students copying and practising those procedures or skills and marking their answers with teacher direction. Drill activities are based in rote learning rather than understanding. Few students demonstrate autonomy and initiative in mathematical behaviour.	2 The bulk of the lesson consists of the teacher describing, explaining and demonstrating procedures for students to copy and practise and the students copying and practising those procedures. Drill activities are based in rote learning rather than understanding. Closure activities include marking and some students voluntarily share their answers and may be asked to explain/demonstrate their solutions. Some students, some of the time, demonstrate autonomy and initiative in mathematical behaviour.	3 Opportunities to undertake tasks involving student decision making and/or active engagement given a few times in the lesson. Students are asked to share their answers and explain/demonstrate their solutions. Part of the lesson consists of the teacher describing, explaining and demonstrating procedures for students to copy and practise and the students copying and practising those procedures. Practice and drill activities are based in students' conceptual understanding. Many students, some of the time, demonstrate autonomy and initiative in mathematical behaviour.	4 A substantial part of the lesson is spent actively engaged in solving problems and sharing those efforts with others. Part of the lesson may consist of the teacher describing, explaining and demonstrating procedures for students to copy and practise and the students copying and practising those procedures. Practice and drill activities are based in students' conceptual understanding. Many students, most of the time, demonstrate autonomy and initiative in mathematical behaviour.	5 The main part of the lesson is spent actively engaged in solving problems and sharing those efforts with others. Teacher may take a teachable moment to explain or clarify a procedure. Practice and drill activities are based on students' conceptual understanding. Most students demonstrate, most of the time, autonomy and initiative in mathematical behaviour.
Problem solving & resources	1 Mathematical resources are either not provided or are not suitable for the mathematical task. Only the teacher has input into the choice of problems and student ideas are not investigated further. Mathematical activities are never open-ended or multi-solution problems.	2 Students are directed to use particular mathematical resources in a mathematical activity. Only the teacher has input into the choice of problems and student ideas are not investigated further. Mathematical activities are rarely open-ended or multi-solution problems and students find it difficult to understand what is expected of them.	3 A limited choice of appropriate resources is available for student use. The choices are dependent on features of the materials (e.g. personal preference) other than appropriateness for solving the problem. Only the teacher has input into the choice of problems and student ideas are rarely investigated further. Mathematical activities are sometimes multi-solution problems and students need assistance to understand what is required of them. Some students can determine an appropriate solution and justify it.	4 A limited range of appropriate and inappropriate resources is available for student use in some activities. Most students can determine if their choice is appropriate and explain this. Sometimes a student's idea will be used to encourage further investigation or thinking. Mathematical activities, for part of the lesson, are multi-solution problems and most students can determine a solution and justify it.	5 A range of resources is available and students can choose which ones they would like to use. All students usually make an appropriate choice and can justify that choice to peers or the teacher. Student ideas are regularly used as a basis for further investigation and students are encouraged to pose problems for problem solving activities. Multi-solution problems are the basis of much of the lesson, and all students, most of the time, can determine a solution path and justify it.

Table 12 Coding guidelines of D3 - effective mathematics teaching

Coding guidelines for Dimension 3 – Significance - in terms of components of effective mathematics teaching					
Building on prior knowledge	Element 13 'Background Knowledge' has been assessed by observation. The assessment of this component 'Building on prior knowledge' is based on my knowledge of how the lesson builds on prior knowledge (whether stated explicitly or not in the lesson).				
	1 The lesson does not build on any previous mathematical experiences or knowledge.	2 Students' previous experience and knowledge have weak links to the content and organisation of this lesson.	3 Students' previous experience and knowledge have some clear links to the content or organisation of this lesson.	4 Students' previous experience and knowledge have many strong links to the content and organisation of this lesson.	5 Students' previous experience and knowledge have substantial links to the content and organisation of this lesson.
Teaching for the transfer of knowledge	1 The mathematical content is the only focus of the lesson with no meaningful links to the process of finding a solution and to other Strands or KLAs.	2 The mathematical content is the main focus of the lesson with trivial or minor links to the process of finding a solution and/or to other Strands or KLAs.	3 At least one meaningful connection is made between the mathematical content and the process of finding a solution and/or to other Strands or KLAs.	4 Several meaningful connections are made between the mathematical content and the process of finding a solution and/or to other Strands or KLAs.	5 Process and content are integrated and/or meaningful mathematical investigations from other KLAs are conducted.

Inductive analysis of data was initially considered, in line with grounded theory as detailed by Strauss and Corbin (1990). However, it was determined that the process would not only interfere with a typical experience of the first years of teaching but the workload would become unmanageable. Therefore, it was decided to reflect regularly on my teaching as any novice teacher might do, using my diaries and programming notes to record my experiences, planning, reflections and thinking.

Issues of reliability and validity

Qualitative research is often criticised over the issues of validity and reliability. Smith (2003) reiterated the view of many qualitative researchers that validity and quality are important in qualitative research, but that they must be judged by appropriate criteria. He highlighted the work of Yardley (2000) and Elliott, Fischer, and Rennie (1999) in suggesting criteria which are wide-ranging and which can be applied irrespective of the particular theoretical orientation of the qualitative study. The criteria Yardley (2000) suggested are:

- sensitivity to context;
- impact and importance;

- commitment, rigour, transparency and coherence.

It is within these guidelines that the issues of reliability and validity have been dealt with in this study.

Being sensitive to the context in terms of this research provides little challenge. The nature of a self-study inquiry, places the researcher into the context of the study. A greater difficulty in this type of inquiry is the need, at times, to distance oneself from the context, in order to bring a researcher's perspective to the issues. Within this context it has been valuable to consider the issue of 'voice' in this thesis. Heaton (1994) also encountered this difficulty in her PhD investigating the experiences of a veteran primary school teacher in endeavouring to implement the NCTM (1989) recommendations for mathematics teaching. She identified seven voices representing herself in her different roles and circumstances throughout her research project. Within this thesis, voice has been given to a number of roles I have taken on in this project: myself as teacher; myself as learner; myself as researcher; and myself as scholar. There are times when these roles are deliberately referred to in providing clarity to the perspective being presented, while at other times these roles are self evident.

Issues of the impact and importance of this research have been dealt with throughout the thesis, with particular attention given in Chapters 1 and 8. Chapter 1 details clearly the significance of this research, while Chapter 8 draws important conclusions, implications and recommendations for further study. The importance of practitioner research is not found in the formal generalisations and theorising associated with validating quantitative research (Anderson et al., 2007). Generalisations in this type of research project involve "a process of reflective action" (Greenwood & Levin, 2005, p. 55) based on an understanding of the contextual nature of knowledge. Recognition of the unique, as well as the ordinary, within a particular context enables the knowledge gained in one context to be reflectively transferred into another (Anderson et al., 2007; Greenwood & Levin, 2005). Stake (1986) argued that "practice is guided less by formal knowledge than by personal knowledge based on personal or vicarious experience" (cited in Anderson et al., p. 45) and that practitioners find formal theorising and generalisations less useful than narrative accounts which provide them with vicarious experience. The impact of practitioner research can be found in the power of personal knowledge through experience, either personal or vicarious, in enabling ownership of change (Anderson et al., 2007).

Every effort has been made to ensure the issues of commitment, rigour, transparency and coherence have been addressed. Triangulation of data has been ensured with video-tapes of lessons, video-taped lesson notes, diaries, programs and program evaluations all being used as data sources. The analyses of all forms of data collected in this study have been rigorous, with the PhD supervisory panel, consisting of three members, reviewing and offering feedback at all stages of the process. In particular, the video-taped lesson analyses, while undertaken by myself as the researcher, have been monitored by the supervisory panel. This panel viewed three of the six video-taped lessons, largely confirming the ratings and conclusions reached, providing suggestions for minor adjustments and feedback on observations recorded in the coding sheets. Subsequently, all of the video-taped lesson analyses were then reconsidered in the light of these suggestions and adjustments made where appropriate.

Ethical considerations

To protect the anonymity of people and places referred to in this thesis the following measures have been taken:

- With the exception of my family members, who gave their written permission to include their names, all names used are pseudonyms.
- The gender of staff members and children referred to in this thesis have no bearing on the study and, therefore, has not been disclosed in either the thesis or data documents. For the sake of alleviating the text and avoiding the use of compounds such as 's/he', adults are referred to using feminine pronouns and children using masculine pronouns.

When referring to school teachers generally in the literature reviews and discussions, feminine pronouns have been used to avoid using compounds such as ‘s/he’ and improve the readability of the text.

In reporting this research care has been taken not to misrepresent or falsify evidence, data, findings or conclusions. To the best of my knowledge, all significant data are represented without omission as they pertain to the chosen research methodology. Clearance for the project was requested and obtained from the UWS Human Research Ethics Committee, Registration Number HEC 01/178.

CHAPTER FIVE

Analysis and discussion of the first year of teaching

Introduction

The next two chapters will provide an analysis and discussion of my first two years of teaching primary school mathematics. This chapter will look at the first year teaching Year 2 part-time and Chapter 6 will focus on the second year teaching Year 4 full-time. Analyses of the transcripts of my programs, my diaries and the notes made when viewing the video-taped lessons, were completed with the aid of the NVivo 2 (QSR, 2002) computer software package. Analyses of the video-taped lessons were undertaken in terms of both the NSW model of pedagogy and review of the mathematics education literature using two instruments:

- The coding scale overview of the 18 elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) (Tables 7, 8, 9, pp. 115-117); and
- The coding guidelines developed to analyse the components of effective mathematics teaching identified by D. and B. Clarke (2004; 1997) (Tables 10, 11, 12, pp. 118-122).

Each term was analysed in terms of the factors and issues that emerged from the data as well as the video-taped lesson analyses, an overview of which is presented in Table 13 (p. 127). Video-taped lessons analyses are placed to reflect where they occurred, in terms of timing, each term. The order in which the issues are presented reflect the importance they had for me in each term. This has been determined by both the number of times they occurred in the data and the nature of those references. Chapter 7 will look at the development of my teaching over the two years, the factors that influenced and constrained my teaching and the issues that emerged from it.

Table 13 Overview of the issues/problems 2002

Overview of the issues/problems emerging from the data in 2002			
Term 1 2002	**Term 2, 2002**	**Term 3, 2002**	**Term 4, 2002**
Behaviour management	Lesson 1.5.02	A change in circumstances	Assessment
Textbook use	Textbook use	Textbook use	Behaviour management
Confidence in my teaching: Including use of elements of best practice	Assessment	Problem solving & investigations	Classroom mathematics routine
Mathematics resources	Problem solving & investigations	Discussion	Mathematics resources
Time constraints	Confidence in my teaching	Group work	Textbook use
Active learning	Discussion	Classroom mathematics culture	Confidence in my teaching
Action Research focus	Group work	Active learning	Problem solving & investigations
	Active learning	Assessment	Active learning
	Mathematics resources	Mathematics resources	Workload
	Behaviour management	Themes	Action Research focus
	Teacher/student relationships	Behaviour management	
	Lesson 27.6.02	Lesson 12.9.02	
	Action Research focus	Action Research focus	

Background and Setting

I commenced this research project in 2001 having just completed a Bachelor of Education (Honours). In the three years since completing the Bachelor of Teaching degree I taught part-time for two years. My main position was part-time as an STLD (Special Teacher Learning Difficulties) providing remedial reading support for students on a one-to-one basis or in small groups. Additionally, I also taught as an RFF (Relief from face-to-face) teacher, teaching PDHPE.

In 2002 I commenced teaching primary school mathematics with a group of Year 2 students at an independent school. I taught these students for four days a week (Mondays through Thursdays) for one hour a day and, with the exception of a page from a mental arithmetic book completed on Fridays with their classroom teachers, their entire mathematics program was completed with me. I was totally responsible for the mathematics programming, teaching, assessment and reporting for this group of students.

At this school classes were ungraded except for Mathematics and English. These subjects were taught at the same time across the primary school to enable the movement of students, considered to be gifted in Mathematics and/or English, to join another grade for these subjects. The group of students I taught were considered to be the middle ability group of the Year 2 cohort. The top and lower groups were taught by the Year 2 classroom teachers.

In commencing to teach part-time in 2002 no orientation program was offered at the school. I met with the Stage 1 teachers the day prior to school commencing and made myself familiar with my teaching space and the available mathematics resources.

Term 1

Goals

Prior to commencing Term 1 I recorded my goals for teaching mathematics at three levels:

1. In terms of how I envisaged myself as a primary school teacher of mathematics in the long term.
2. For my first year of teaching mathematics.

3. My priorities in the first few days of teaching.

1. Long term goals

In the long term I wanted to teach mathematics by:

- Providing non-routine problems to stimulate student thinking and encourage students to work out their own ways of solving these problems and sharing these different ways.
- Encouraging a way of doing mathematics which does not focus on right/wrong solutions but focuses instead on thinking, problem solving, testing, rethinking, explaining and justifying.
- Using praise for social behaviour rather than mathematical activity. Instead I want to ask stimulating and probing questions to scaffold further thinking and, therefore, learning.
- Establishing my role in the class as a facilitator of mathematics learning but not the judge of right and wrong answers and procedures while maintaining a respectful learning environment for myself and my students.
- Establishing and maintaining effective group work (Diary Y2 T1 2002, 8-12).

Having recorded these thoughts I reflected “I’m going to find this difficult and will have to work at this for a long time - I’m envisaging taking this a step at a time and may focus on this in my personal action research” (Diary Y2 T1 2002, 14).

2. Medium term goals

In 2002 my aim was to:

- Provide learning experiences which stimulated all students to develop mathematical thinking, concepts and skills which they can utilise in real life situations and build on solidly for the future.
- Form positive relationships with my students where they enjoyed me coming to their classroom.
- Encourage positive attitudes to mathematics in my students (Diary Y2 T1 2002, 3-5).

3. Short term goals/Immediate priorities

In my first few days of teaching I wanted to:

- Establish my position as the teacher in terms of behaviour management (Diary Y2 T1 2002, 22).
- Establish relationships and start to know names.
- Have plenty to do to fill in the time.
- Have both the resources and room ready.
- Have no discipline issues - I was determined to establish class rules and expectations.
- Be familiar with the textbook and speed test booklets (as they were compulsorily used at the school).
- Use the topic from the text as a basis for Addition 3 and use the Syllabus[7] (NSW Department of School Education, 1989) activities as a basis for my lesson.
- Use whole class, pair work, possibly group (but not on the first day) and individual work (text, speed tests) (Diary Y2 T1 2002, 45-51).

The issues that emerged from the analysis of the data in Term 1 included behaviour management, textbook use, confidence in my teaching, the use of mathematics resources, time constraints in mathematics lessons and issues concerning active learning and are detailed below.

Behaviour management

Behaviour management emerged from the data as the main issue when I began teaching, with all of the ten references occurring prior to Week 8. Prior to school commencing my first priority was to “establish my position as the teacher in terms of behaviour management”, commenting “While I have other ‘bonus’ goals this week I have to say this is my main focus and the one

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[7] The Syllabus in Chapter 5 refers to NSW Department of School Education. (1989). *Mathematics K-6*. Sydney: Author and is hereafter referred to as the Syllabus without referencing.

I feel most fearful of failing in, as it has long term consequences" (Diary Y2 T1 2002, 22-24). I had thought through the behaviour management strategies I would use and acquired the stickers that I would use as a reward for appropriate behaviour (Diary Y2 T1 2002, 27).

Five of the eight aims for my first week of school (Diary Y2 T1 2002, 22, 46-48) included strategies to minimise the possibility of behaviour management problems by:

- Addressing students by name, which while having other advantages, is beneficial in ensuring that problem behaviour can be focused on immediately without having to try to get a student's attention.
- Having plenty to do to fill in the time, by providing "a variety of activities which are highly structured but enjoyable" (Diary Y2 T1 2002, 28).
- Keeping the distractions of setting up and room organisation to a minimum.

My first lesson occurred on the Monday of the second week of term, school having commenced on the Thursday of Week 1. In the evaluation of that lesson I mentioned behaviour management three times (Program Y2 T1 2002, 90-91, 95) and at the conclusion of the second lesson I noted a small group of children that I thought might prove a challenge and reiterated that "I need to be firm in administering behaviour rules (Diary Y2 T1 2002, 58). After seven weeks of teaching I noted that behaviour management was a regular point of conversation with the other teachers (Diary Y2 T1 2002, 111-112). These discussions pertained to individual student difficulties in both the mathematics group and home classes, including issues that might affect student behaviour and the clarification of behaviour management routines at the school.

The priority behaviour management was given is clear both as a general concern and in the minute-by-minute operations of my early lessons. It was central to my fear of not being perceived by other staff as competent. It affected the choice of activities that I was willing to try in an open teaching space, where I was exposed to scrutiny by staff in surrounding classrooms as well as those passing through the room, because “my experiences in schools have led me to believe that teachers are very critical of other teachers who have noisy classes and often equate this with the teacher having poor class control” (Program Y2 T1 2002, 90). I commented in the evaluation of my second lesson: “I am so focused on classroom control, setting up the next activity and seeing that they run smoothly I am not really looking for student thinking in either their behaviour or responses” (Program Y2 T1 2002, 95).

Dealing with inappropriate behaviour became an issue in the term due to my part-time status. The school had no Stage approach to discipline issues and follow-up for repeated disruptive behaviour was the sole responsibility of the classroom teacher. Therefore, I had to be available for lunch time detentions, as it was unreasonable to expect the classroom teacher to provide supervision for a problem that was experienced in my class. While it took some time, once the students realised that a lunch time detention was consistently applied for repeated inappropriate behaviour, those exhibiting difficult behaviours settled down and the need to implement lunch time detentions was reduced (Diary Y2 T1 2002, 116-120).

Textbook use

The use of the textbook emerged as the major constraint in developing the components of best practice in my teaching in Term 1. The textbook was compulsory at the school and it needed to be used almost every day (Diary Y2 T1 2002, 37, 147). I introduced a mathematics diary in the first weeks of term (Diary Y2 T1 2002, 74) but found the limited reading and writing skills of this age group, coupled with the mandatory use of the textbook, made it extremely difficult to provide two written activities in the restricted lesson time available.

The textbook is frequently referred to in terms of the time it took for the children to complete, often up to half an hour of the hour lesson (Program Y2 T1; 431), taking time away from activities I saw as more worthwhile such as non-routine problem solving (Program Y2 T1 2002, 344, 431; Diary Y2 T1

2002, 49, 147). It limited students' solution attempts (Program Y2 T1 2002, 206) and provided procedural approaches to understanding at the expense of conceptual development (Program Y2 T1 2002, 241-245).

The textbook is also referred to in terms of the difficulties children had in reading it and the need to ensure that those with less advanced reading skills were not disadvantaged. This was done by my reading out each page and making sure it was understood by all students which was often a tedious process, especially for those that did not need the assistance (Program Y2 T1 2002, 250). I highlighted the way this added to a teacher dominated mathematics classroom (Program Y2 T1 2002, 431).

At the end of the term I reflected: "I feel textbook driven and I don't know how to deal with this. The textbook is imposed by the school and nearly every day a page is assigned. Some weeks there were five [pages] assigned for four days (Week 11). A sign of the importance of this was given by another Year 2 teacher (her second year out) who said 'I'm going to have to leave out p.?, the children just won't be able to do it this year'. The program is so tight that there is nearly nowhere to 'make-up' a missed page" (Diary Y2 T1 2002, 147).

The textbook provided no space for recording student thinking and needed to be marked with a tick or a cross. While I struggled with my natural inclination to give evaluative right/wrong type of feedback to students in our lessons, I had made a conscious effort to downplay the need to be right, talking about mistakes being great opportunities to learn and commenting on students' thinking and responses rather than answers. My long term goal of achieving a classroom culture that was not focused on right or wrong answers was still a long way off and my efforts were immediately undermined by the textbook and marking. I reflected "What do I do? I have to mark - is there another way to mark?" (Diary Y2 T1 2002, 150).

Confidence in my teaching

My competence and others' perceptions of my competence emerged as a concern for me in this term. I was at the school in this first term on an unpaid trial basis and, therefore, I was concerned to "establish myself as competent and acceptable in the school...[and] to 'fit in'" (Diary Y2 T1 2002, 41) in order to continue my project. Approval for my continued teaching was given in the last week of term, when I was told I would be paid for my work for the rest of the year (Diary Y2 T1 2002, 143).

Behaviour management was one of the factors which I related to being a competent teacher and the level of noise in a class the common criterion for judging a teacher's behaviour management skills (Program Y2 T1 2002, 90). This belief is one established in my own schooling and confirmed by "my experiences in schools [which] have led me to believe that teachers are very critical of other teachers who have noisy classes and often equate this with the teacher having poor class control" (Program Y2 T1 2002, 90). I also believed that poor behaviour management had "long term consequences" (Diary Y2 T1 2002, 24). While these are not specified, they involved the difficulties of teaching without adequate classroom control and the problem of gaining control when it had been lost. Interestingly, I had never experienced these difficulties but there was a sense of apprehension that I might encounter the child or the class that I could not handle.

Two incidents recorded in the diary demonstrate how a lack of confidence in my own judgement affected my decisions this term:

- In Week 8 I was asked if I would like photocopies of the net of a cube so my class could join the other two classes in making a cube as part of the 3D Space unit of work. "I agreed, but was taken aback by its use in connection with 3D3. I didn't say anything but looked up the Syllabus to check if I thought it would fit. I didn't and noted that the language 'cube' would not surface until 3D7. Looking again now I see it was an activity associated with 3D9 (nets) (Diary Y2 T1 2002, 124). Despite my misgivings about the activity my class decorated and made the cubes.

This was done with great difficulty because it required a level of fine motor skills, the ability to manipulate objects precisely and accurately (Kostelnik, Soderman, & Whiren, 2007), most students did not possess at this stage of their development. I felt that it had been a frustrating waste of time, in terms of meeting the outcomes and scaffolding my students' understanding of 3D objects. My discussions with the other teachers revealed totally different understandings of the Syllabus outcomes and expectations of our students (Diary Y2 T1 2002, 126). I reflected: "I have tried to analyse why I did it when I was not comfortable with it and I have concluded it was because I want to 'fit in' with the other classes. I don't want my children to feel that they missed out and I was not confident enough in my own understanding of the Syllabus. The Year 2 classes completed the same activity last year (I was told) with the Stage Coordinator as one of the teachers...I felt intimidated by their experience (not them) and worried about doing the wrong thing for my children and fitting in to the other teachers' expectations" (Diary Y2 T1 2002, 128).

- In Week 9 I reflected on my students' understanding of the basic facts of 20, as evidenced in daily speed tests for the whole of the term. The speed test booklets were testing facts up to 13 but many students were struggling with the facts up to 10 and for some there had been little improvement over the term. In the three minute test some students were completing six questions while one could complete the page of 50, with many students completing between 10 and 30 (Diary Y2 T1 2002, 133). In reflecting on the possibility of scaffolding student learning with number fact investigations and making my own speed tests which progressed more slowly, I wrote "Is this the way to go? I feel nervous about abandoning the speed test because of the other classes doing them - I might run this past someone. It's awful to feel so lacking in confidence that you don't trust your own judgement (Diary Y2 T1 2002, 137).

The pace of the program made me fearful of taking time to allow students to 'discover' a concept for themselves (Diary Y2 T1 2002, 91-93), having no idea of how we could 'make-up', not only content coverage but textbook completion if I took extra time for this. My concern to cover the content requirements for the year made me nervous of being too adventurous in my efforts to implement elements of best practice.

Best practice at this stage of the project was based on Clarke's (1997; 1999) seven components of reformed teaching which included the teacher's approach to the selection of content, problem solving, student needs/interests, classroom organisation, discussion, assessment and reflection. At this stage I had not made any explicit plans about how to implement them, but they were in the back of my mind throughout the term. I expressed my difficulties with implementing several of these components:

1. Identifying and focusing on the big ideas of mathematics:
   In the second week of term I recorded that my lack of experience with the Year 2 program meant I had a 'bitsy' approach to my teaching and hoped that the experience of programming would give me some insight into the 'big ideas' (Diary Y2 T1 2002, 81).

2. Providing non-routine problems as a starting point and focus:
   I did not know where to start in providing non-routine problems to my class. Firstly, I was fearful of not covering the content and secondly, I did not know where to find appropriate problems or how to go about making my own (Diary Y2 T1 2002, 89). The Syllabus was my only source of problems other than the textbook. My own research had only located books on problem solving and I could not see how to integrate those types of problems into regular lessons.

3. Utilising a variety of organisational styles:
   My first effort to utilise group work occurred in the second lesson of the term and did not go well. The lesson was planned around rotating groups doing three different activities - one of them being the textbook - (Diary Y2 T1 2002, 53-54) and it was a bit chaotic; "there was too much happening at once and too many students needing assistance all at once. I tried to change the setup when it became apparent I would need to go through each activity step-by-step as the children did them" (Program Y2 T1 2002, 97). Most lessons after this used pair work quite effectively until I felt I was better prepared to try group work again.

At the end of Week 8 I reported on a lesson which had focused, from my perspective, on introducing productive group work. Clear guidelines for group work behaviour were explained and reinforced with a reward for the 'best' group. I reported "Generally the session went well, and students explored, categorised [and] explained their activities quite well for a first real group activity" (Diary Y2 T1 2002, 122). In the following week activities were again done in groups and reported positively (Program Y2 T1 2002, 344).

4. Developing a mathematics discourse community:

   At the end of Week 2 I noted that I was finding it difficult to make time for worthwhile discussion. The little time we had was spent with me asking questions and students answering them, to consolidate what had been learnt. I also reported that sharing answers was a problem because students were having difficulties listening to other students (Diary Y2 T1 2002, 90; 94). I noted some work on this in Week 8 where "I spent a considerable time talking about acceptable behaviours and we discussed the reasons we need to use materials sensibly, cooperate with each other in the group, complete the set task, keep noise at a reasonable level and listen to others' explanations" and I reported in this lesson that students "explained their activities quite well" (Diary Y2 T1 2002, 122).

5. Using informal assessment to inform instruction:

   Difficulties in assessing students' mathematical thinking are referred to several times this term. In the first lesson I reflected that I had so much else happening that "I am not really looking for student thinking in either their behaviour or responses" (Program Y2 T1 2002, 95). At the end of Week 2 I noted "I need to focus on student thinking more, I am doing this, to a degree, in marking and I take notes, but I need to be more aware in lesson time" (Program Y2 T1 2002, 112). The following week I again expressed the need to plan for assessing student thinking, but I asked myself "How do I find time to spend time observing all students? Discussion?...Students' mathematics diaries? (Diary Y2 T1 2002, 95). I came to no conclusion and continued to battle with this issue.

Mathematics resources

The significance I gave to having adequate mathematical resources for my students is evident in my planning prior to school starting (Diary Y2 T1 2002, 47) and my decision at the end of Week 2 to program around the materials available, because of the difficulties I had locating appropriate resources (Diary Y2 T1 2002, 79). The availability and location of equipment became a major point of communication with the other staff and my school supervisor (Diary Y2 T1 2002, 111-114).

The use of manipulative materials is listed for every lesson in Term 1, both as an intention of programming and in evaluating lessons. They were programmed for a variety of uses including:

- investigations or solving problems (Program Y2 T1 2002, 167, 213, 214, 297, 325, 327, 354, 358, 359-360, 385-386, 389-390, 412, 415);
- to model mathematical concepts (Program Y2 T1 2002, 174-176, 258-260, 265, 319, 380-382);
- to scaffold the introduction and development of written forms of mathematical activities (Program Y2 T1 2002, 291, 381-382); and
- to play mathematical games (Program Y2 T1 2002, 320, 414).

Program evaluations included:

- their effectiveness (Program Y2 T1 2002, 84, 151, 194, 198, 204, 345);
- difficulties in locating appropriate resources (Program Y2 T1 2002, 89, 92, 94, 194, 204, 281);
- observations of how students used them and how these indicated their understanding (Program Y2 T1 2002, 159, 251); and
- my frustration at students' off-task behaviours when using them (Program Y2 T1 2002, 204, 372).

Time constraints

Time emerged from the data as a significant constraint this term. The school's compulsory use of a textbook and the grade-wide use of a daily speed test, coupled with settling the children, transition times and rewarding appropriate behaviour, reduced time for other mathematical activities to 15-20 minutes. The textbook was partially blamed for this (Program Y2 T1 2002, 344, 431), some days taking half an hour to complete (Program Y2 T1 2002, 431). At the end of the first week of teaching (Week 2) I resolved to cut back on the number of activities in a lesson (Program Y2 T1 2002, 106), but the problem persisted and in Week 6 I complained that I am still "'over' programming and running out of time" (Program Y2 T1 2002, 277). The main result of running out of time was the difficulty in providing a proper conclusion to the lesson in terms of worthwhile discussion (Diary Y2 T1 2002, 90). Interestingly, because I was only teaching mathematics I was able to have everything set up prior to the lesson, including resources, students' books and stationery, as well as marking students' textbooks after the lesson.

Active learning

With the exception of the speed tests (Diary Y2 T1 2002, 132-133) and some of the textbook work (Program Y2 T1 2002, 241-245), nearly all of the mathematical activities provided in Term 1 would be classified as encouraging active learning i.e. the provision of tasks that encourage students to actively engage in constructing meaning rather than simply absorbing or reproducing knowledge (Newmann et al., 1995). These activities usually took between 15-20 minutes of each lesson, unless they were associated with the textbook pages for the day (usually in relation to Space and Measurement activities), when they would take up the bulk of the lesson e.g. completing the Mass activities in the textbook using equal arm balances (Program Y2 T1 2002, 390). When Number pages were the focus of the textbook these would often be supported by the provision of concrete materials to scaffold their completion (Program Y2 T1 2002, 214, 354, 412).

Newmann et al. (1995) warned that heightened engagement does not ensure student learning and "can produce work that is intellectually shallow and weak" (p. 1). The NSW model of pedagogy encourages teachers to use pedagogy that promotes high levels of intellectual quality through active engagement in higher-order thinking (NSW Department of Education and Training, 2003a). At the time I was not satisfied with most of the activities I was providing, as they were more often than not 'hands-on' activities, solving routine problems rather than opportunities to solve non-routine problems (Diary Y2 T1 2002, 91) and to engage in higher-order thinking. One activity, where I felt an opportunity had been provided to enable students to develop a sense of 'ten-ness' and see for themselves the benefits of bundling in 10s, required many more experiences than the program allowed for. Hence, the benefits of grouping in 10s did not emerge from students constructing their own meanings from the experiences, but from my very leading discussion and one student's recall of trading in a lesson in Year 1 (Diary Y2 T1 2002, 91-93).

Action research focus

Commencing the project I had no specific action research focus in this first term, although I had listed my goals (Diary Y2 T1 2002, 3-5, 8-12, 22, 45-51). I had commenced the term looking to 'fit in' with school expectations, the Year 2 staff and the Stage coordinator (Diary Y2 T1 2002, 108), while endeavouring to teach using the principles of best practice that I had acquired through my teacher preparation course and the mathematics education literature.

At the conclusion of the term I reflected upon my experiences with consideration to the biggest difficulties I saw in achieving my goals and concluded that I was "textbook driven" (Diary Y2 T1 2002, 147). I discussed this with a well-known mathematics education academic visiting the university from overseas and decided to focus on providing non-routine problems (Diary Y2 T1 2002, 150, 153), the first of my long term goals (Diary Y2 T1 2002, 8), to address this difficulty. Coupled with the decision made in Week 9 to scaffold students' understanding of the basic addition and subtraction facts with investigations, this became my focus in Term 2.

Term 2

This term included two video-taped lessons, the first in Week 1 of the term, the second in Week 9. The first lesson taped on 1.5.02 was a replacement for that scheduled in Term 1 Week 11 in which the recording equipment had failed.

Lesson 1st May, 2002

Table 14 Year 2 1.5.02 - Coding sheet Dimension 1

Year 2 1.5.02 - Coding sheet Dimension 1 – Intellectual Quality					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
1.Deep knowledge	This lesson focused on two things: facts of 5 and the use of money. Some of the money activities were superficial, focusing on the identification of coins and notes based on animals displayed on each (though this was examined the previous year).	3	Content	The big ideas addressed in this lesson were: 1. The patterns of the addition and subtraction facts of 5 - Addition 4 and 5 (1989, pp. 214-215). This was appropriate and well focused throughout this part of the lesson. 2. The tendering of the correct amount in coins and notes was Money 4 and 5 (1989, pp 281-282) and I noted at the time the activity was a "little too difficult". I had actually programmed for the recognition of the face value of coins and notes and trading coins up to $2 from Money 2 & 3 (1989, pp. 279-280) but in my effort to provide a multi-solution problem had lost focus on the Syllabus. Therefore, the focus of the money lesson was not appropriate.	3 A combination of 4 for the addition facts and 1 for the money game.
			Explicit focus	Explicit focus on identifying facts and patterns was talked about in basic facts investigation. The focus of the money game was not made clear although it was evident in what the students were required to do.	3
2.Deep understanding	Understanding is uneven. Deep understanding is shown by some students in their explication of their strategies in working out number facts, identification of patterns as well as choices of notes and coins when playing the shopping game.	3	Teaching for conceptual understanding	A mix of approaches is evident (Investigation of basic facts of 5, textbook work on money and money game) and some of them are designed to support a conceptual understanding: 1. The facts investigation was designed to scaffold the development of a conceptual	3

Year 2 1.5.02 - Coding sheet Dimension 1 – Intellectual Quality					
4.Higher-order thinking	Higher-order thinking was required in identifying patterns in their facts investigation and most students were able to do that. Lower order thinking was all that was required in the completion of the textbook page on money. Some students used higher-order thinking in working out which coins and notes to use as they wanted their solutions to be different to the majority of the class.	3		understanding of the facts of 5, the patterns and strategies used to work them out. 2. The money activity was to give a multi-solution opportunity to work out which notes or coins could be used to tender the exact amount of money required to buy something. Manipulative materials were used to support an understanding of facts.	
3.Problematic knowledge	The money game questions were open to different solutions.	3	Problem solving	The investigation of the facts of 5 was meaningful and challenging. The use of plastic money to tender correct amounts to buy something was meaningful but too challenging for some students. The textbook work did not involve problem solving.	2 This is difficult to code because of the incorrect focus of the money lesson.
5.Metalanguage	'dollar', 'cents', 'addition', 'plus', 'subtraction', 'minus' all used but no explanations. The use of money symbols was explained and students offered suggestions.	3	Discussion	Discussion of the money game solutions was very brief and I dominated it by demonstrating solutions. Students' thinking was not probed or made visible.	2
6.Substantive communication	In their written work students showed the facts of 5 they had found and showed the patterns they could see. Discussion of the money game solutions was superficial – it was hard to hold student attention.	3	Written work	Children wrote the number facts of 5 (+ & -) and showed patterns in their grid books. They completed the textbook page, but this was not substantive communication.	3
			Student reflection	The recognition and demonstration of patterns in the basic number fact investigation allowed for reflection but this was mainly shared in the written work and not all students could show patterns. The discussion of money game solutions was focused on correct answers though student thinking was referred to when alternate answers were looked at once or twice.	2

Table 15 Year 2 1.5.02 - Coding sheet Dimension 2

Year 2 1.5.02 - Coding sheet Dimension 2 – Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	Explicit instructions were given for finding the addition and subtraction facts of 5 including finding and showing patterns. Some students used these as a basis for asking for help. The required behaviour for listening when others were speaking was explained and reiterated.	3			
8.Engagement	Engagement was variable. Most students were engaged for much of the lesson, except in sharing/discussion time when several students evidenced off-task behaviours.	4	Motivation	There was appropriate variety in the activities of the lesson and while some of the activities were interesting and challenging the money game was too challenging for some students. The pace of the lesson was good most of the time, though finding the balance between discussion and keeping students interested was difficult. Not enough time was spent on discussion to make it worthwhile, but more than enough was spent on it to keep most students on-task. The use of mathematical resources was motivating.	3
			Mathematical resources	The plastic money did not have the same details on them as real money and this made answering questions regarding the details on the coins difficult in the textbook page. Laminated squares were appropriate for the number fact investigation. Resources were sufficient for the tasks	3
9.High expectations	Most students were involved in challenging work for at least half of the lesson. Many students showed evidence of identifying patterns in their grid books. All groups had solutions for the money that needed to be tendered in the money game. However, some groups were very quick, some of them finding different solutions but some also waited around for other groups to complete a solution to share. Most students were working hard and on-task most of the time.	3	High expectations of behaviour	Appropriate behaviour was talked about repeatedly throughout the lesson and unacceptable behaviours were dealt with appropriately and consistently throughout the lesson. Appropriate behaviour for discussions was mentioned several times before and during the discussion, but many students still behaved inappropriately. It was difficult to be consistent in dealing with this as so many students struggled with it and getting the balance between a fruitful discussion and acknowledging the difficulty of concentrating unless really	3

Year 2 1.5.02 - Coding sheet Dimension 2 – Quality learning environment					
				interested was difficult. The aim was to support the development of these behaviours in classroom discussions.	
			Risk taking	The discussion time focused on 'right' and 'wrong' answers rather than thinking. Many students asked for help. Rules for appropriate behaviour were explicit.	3
10.Social support	Social support was clearly positive with clear attempts by me to support reluctant or struggling students. Discipline and classroom management included positive and negative reinforcement.	4	Social organisation	There was variety with whole class, individual and pair or small group work. Most pairs worked quite well together, though in some groups some students dominated rather than cooperated.	4
			Teacher's relationships	I was relaxed. Positive relationships with most students were evident, though I still needed to make explicit directions concerning some students' behaviours.	4
11.Students' self-regulation	Many students regulated their own behaviour appropriately for this age group, but I needed to manage inappropriate behaviour several times. I had to remind the class of the required behaviour in discussion times as many students were off-task at this time.	3	Student autonomy	The inappropriate behaviour of 5 or 6 students caused interruption to the lesson several times. In the discussion more students were unsettled and off-task.	3
12.Student direction	The choice of whether to use squares to scaffold their identification of the basic facts of 5 was not trivial. The money game provided multi-solution questions.	3	Problem solving & resources	The money game involved problems with multi-solutions. The students were also given the choice of whether or not to use the squares provided for the investigation of basic facts.	2

Table 16 Year 2 1.5.02 - Coding sheet Dimension 3

Year 2 1.5.02 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	Aspects of previous number fact investigations were mentioned briefly. Money experiences outside of school were referred to but not substantially.	3	Building on prior knowledge	The basic fact investigation was based on experiences over the previous 2 weeks. These included investigations as a whole class, with a few experiences of completing an investigation in a small group. Looking for patterns and explicating strategies were just starting to become the norm for these investigations. Money	3

Year 2 1.5.02 - Coding sheet Dimension 3 – Significance					
				experiences outside of school were built on but the money game did not fit with the Syllabus content focus and, therefore, did not build on school money experiences.	
14.Cultural knowledge	Use of Australian coins and the details of their appearance and worth was discussed, but it was treated superficially.	2			
15.Knowledge integration	Money and HSIE integration – in terms of the details on the coins (animals). This was done via the textbook and treated superficially.	2	Teaching for the transfer of knowledge	Meaningful connections between the basic addition facts and the process of working them out were made several times. The money game provided some links between content (i.e. The face value of coins and notes) and the process (i.e. What notes or coins are needed to buy a particular item) despite the fact that this was not the intended focus of this lesson)	3
16.Inclusivity	All students included most of the time.	4			
17.Connectedness	The lesson had real life connections to the use of money and these were explicated and not hypothetical or abstract. No effort to influence an audience beyond the classroom was made.	3			
18.Narrative	There was use of narrative in the presentation of the money problems.	2			

Reflection on the lesson of 1st May 2002

This lesson was taught at the very beginning of my efforts to introduce non-routine problems and basic addition and subtraction fact investigations. The unfamiliarity of these activities is evident in my tentative approach, being unsure about the sorts of student responses to expect and the students being unsure of teacher expectations. A new didactical contract (Brousseau, 1984, 1997) was being explored, neither the students, nor myself, being sure of its detail in terms of reciprocal expectations.

Textbook use

Term 2 2002 saw a particular focus in my entries on the use of the textbook (25 entries in the four different documents), which emerged as the main issue this term. While it was referred to positively in two activities (Program Y2 T2 2002, 112, 169-170, 171), it was usually described in terms of the problems it caused.

The textbook often took a considerable amount of time to complete and some students found it tedious and daunting (Video-notes 27.6.02, 50, Video-notes 1.5.02, 59; Program Y2 T2 2002, 109, 267, 303). I felt it was taking time that would have been better spent on solving non-routine problems (Video-notes 1.5.02, 59). In an effort to reduce the impact of the time the textbook took I marked it myself, although I had tried to get the students to mark some of their own work, which had not only taken up valuable time, but had been unreliable, with some students marking incorrect answers as correct (Video-notes 27.6.02, 50). I recorded that marking regularly took me 40 to 60 minutes a day and commented: “I don’t know if I could maintain doing all the marking if I was teaching all subjects” (Video-notes 27.6.02, 50).

Many students had difficulties reading the textbook and there was a need to ensure that those with less advanced reading skills were not disadvantaged. This was done by my reading out each page to ensure it was understood by all students (Video-notes 1.5.02, 61). My concern was that this contributed to a teacher directed mathematics classroom (Video-notes 1.5.02, 61).

As it was compulsory, the textbook took precedence over other mathematical activities (Program Y2 T2 2002, 80). It did not always cover the content of the Syllabus adequately (Video-notes 1.5.02, 63; Program Y2 T2 2002, 202, 203) and undermined my efforts to establish a classroom culture that valued thinking above right or wrong answers (Video-notes 27.6.02, 52).

In Week 4 I reflected on a meeting with my school supervisor: “In passing I mentioned my frustration with the textbook, the amount of time it took. She told me that she sometimes left out questions or did some of them because of the quantity, but felt that students benefited from written work because this is the format they will see in the future - ‘work’ and ‘testing’. I see this is valid but surely a black line master (BLM) book used where appropriate would satisfy this” (Diary Y2 T2 2002, 26). Following this I spoke to Bobbie (Year 2 teacher) who said she had been told they are compulsory from K-6. I reflected with dissatisfaction: “Because of the policy and my insecurities I have had some frustrating lessons where problem solving activities have been going well and productively but I have had to bring them to a close to ‘do the page’ because there is no other time to catch up” (Diary Y2 T2 2002, 30).

I would have appreciated the freedom to utilise a variety of written forms of mathematics work that took into account the differing learning needs of my students and gave them opportunities to communicate their thinking in words and drawings. Activities that engaged them in solving multi-solution or non-routine problems which produced all of the computational work required by a page of addition or subtraction problems without them being daunted by the task. However, the amount of time required for the compulsory use of the textbook allowed no time for the development of this type of written mathematics. I reflected at the end of Week 5 “I hate using the textbook. As I have gained experience and feel confident about class control and being accepted at the school as competent, I am thoroughly frustrated by feeling ‘driven’ by the textbook. Every week, at least three of the four days a page is required, some pages taking half an hour to complete (even then some children don’t finish). Children lose interest and get distracted by friends, some just daydream. Some find the amount of work on the page daunting and give up. A lot just have trouble understanding what to do - some of the problem is ‘mathematics’ related - a lot is ‘reading’ related and some is just maturity in understanding directions and being able to follow them” (Diary Y2 T2 2002, 58).

Assessment

Terms 2 and 4 are reporting terms and in this, the first of the reporting terms, assessment emerges as an important issue. Assessment for both reporting and to assess student thinking were very difficult for me to do in the course of a lesson. I recorded: “I do my best to walk around and listen to [the students] working, asking questions to clarify thinking. But I often forget who said what, and I have tried, but find it difficult, to take notes or tick boxes and do all the other things I am doing (even if these are not obvious outward actions, I am thinking flat-out about all sorts of things including discipline, content, children's thinking, what I'm going to do next in the lesson, responding to a question, thinking how I can help a child). I presume as my confidence and experience grow I will have less of that happening in my head and will find the assessment of mathematical thinking more manageable” (Video-notes 27.6.02, 52).

In terms of reporting, a half yearly examination was administered to assess some of the 19 reporting outcomes. Some outcomes could not be assessed formally and required the observation and questioning of students as they completed a set task. Some items were inadequately assessed by the examination and subsequently, also required observation and questioning to give a fair assessment (Diary Y2 T2 2002, 71, 73, 75, 78). At the end of the reporting process I reflected: “I have found the assessing for reports very difficult and frustrating and tedious. However, I’m glad I did it [taken time to observe tasks that were inadequately assessed in the examination]. My classroom observations did not necessarily lead me to the same assessment of children’s understanding as ‘1:1, hands on’ did” (Diary Y2 T2 2002, 82). Clarifying students’ understandings of the reported outcomes, by observing students as they completed tasks and asking them to explain their actions or solutions, often resulted in a different rating than that given as a result of the examination and/or observations in classroom activities.

The main issue that emerged from the assessing and reporting process was the time it took to complete the observation of students’ undertaking assessable tasks and questioning their responses (Program Y2 T2 2002, 211; Diary Y2 T2 2002, 32-35, 60-61). In Week 4 I commented: “We have nineteen outcomes to report on, most of them activity based and not assessable by a pen and paper test. How do I assess twenty three children on nineteen activities to prepare a report? Ridiculous!!!” (Diary Y2 T2 2002, 33). Subsequently, it took priority over other programmed lessons (Program Y2 T2 2002, 207, 209, 211) and I still needed to go to school for an extra two and a half days (Diary Y2 T2 2002, 78), withdrawing students from their normal classes. When reports were completed at the end of Week 7 I commented: “I found it stressful and I only did mathematics” (Diary Y2 T2 2002, 61).

A secondary but important issue that emerged was the difference in thinking between myself and the other Year 2 teachers/Stage coordinator, not only on the suitability of some questions in the examination to assess the stated outcomes (Diary Y2 T2 2002, 70, 71, 73, 75), but in our different understandings of what we were assessing for in the outcome (Diary Y2 T2 2002, 35, 71). The basis of these differences seemed to be my struggle with the ‘right answer’ approach to mathematics education, where my focus on the mathematics curriculum was the process rather than the product.

Frustration was experienced because the program was not adequately structured to cover all of the content prior to the examination (Diary Y2 T2 2002, 75) and the examination was moved forward a day without notice, so my students were examined on content they had not been taught (Diary Y2 T2 2002, 75; Program Y2 T2 2002, 203-205). Reporting was not computerised and I commented: “Writing up reports by hand seems crazy with computerised everything [else]. The last school I was at had reports on computers two years ago and it was a lot less resourced than this one. Rewriting errors is such a pain” (Diary Y2 T2 2002, 61).

Problem solving

The action research focus for this term was the introduction of non-routine problems and the video-taped lesson of 1.5.02, the first day of the term, was my first attempt to provide a problem that had more than one solution. At the time I had no teaching resources to support my selection of problems and based my money problems on the type of questions I had experienced in my university course. The problems provided involved children buying items from their partners for a specified price. They were multi-solution but still routine and the students had no problem in understanding what was expected of them. In my evaluation of the lesson I concluded that the tasks had been “a little too difficult” and in my video-tape notes I reflected that being in the early stages of trying to implement a problem solving approach it had “been reasonably successful” (Video-notes 1.5.02, 59). My criteria had been that the question needed to have more than one solution, all correct solutions were acceptable in answering the question and incorrect solutions were discussed and modified (Video-notes 1.5.02, 59).

At the end of Week 2 I acquired four teachers’ resource books focused on supporting a problem solving approach to teaching mathematics (McIntosh, De Nardi, & Swan, 1994; Skinner, 1990, 1998; Sullivan & Lilburn, 1997). These supported the teacher in identifying and designing ‘good’ problems and, using these as a basis, I made some plans to introduce non-routine problems into my lessons (Diary Y2 T2 2002, 5). In the third week of term I gave the first non-routine problem in a lesson on subtraction. The students were confused as to what to do, some saying that there was not enough information to answer the question. I modelled a solution to scaffold their understanding and recorded: “It was great to see how enthusiastically their responses changed after I modelled an answer (Farmer Brown had 4 eggs, he used 2 to make his breakfast, now he has 2 left). I felt this was my first real attempt at posing non-routine problems, and it went really well. The children did lots of subtractions in answering the question, there was not just one solution. The children had to decide what operation to use to work out an answer, as well as the story to go with it. It was great!" (Program Y2 T2 2002, 110).

This focus on providing non-routine problems continued throughout the term and the entries saw students accepting this type of activity as a normal part of mathematics lessons (Program Y2 T2 2002, 140, 165, 238, 309, 310, 322). By the time the second lesson was video-taped on 27.6.02 the students had become considerably more comfortable with non-routine problems, no longer baulking, no longer saying that they did not know what to do, or that they did not have enough information to answer the question (Video-notes 27.6.02, 26, 49). At the end of the term I reflected on my efforts to use non-routine problems in my lessons. This is described as a "struggle" when trying to complete the specified textbook pages, assess for and complete reports (Diary Y2 T2 2002, 85). I reflected "I have made some headway which was evidenced today in my video-taped lesson when no children baulked at what I was asking of them having seen these non-routine or open-ended questions before" (Diary Y2 T2 2002, 87).

Investigations

Investigations had been a part of the mathematics program in Term 1, particularly in the Space and Measurement strands, but also in the Numeration and Addition sub-strand and this continued in Term 2. However, investigation of basic addition and subtraction facts became a regular part of lessons this term, as a result of the difficulties experienced by many of the students in the daily speed tests in Term 1. In Term 2 these investigations were established as part of the class routine and students developed skills in identifying and discussing patterns, as well as identifying and describing mental computation strategies they could use to solve addition and subtraction problems.

In the first lesson of the term, video-taped on the 1.5.02, the students undertook their own investigation of facts of 5 and wrote down the addition and subtraction facts and showed patterns. This had followed on from some whole class investigations at the end of Term 1 and was their first individual attempt. I reflected: “This was a start, not a great one, but hopefully it will improve with repetition and familiarity” (Video-notes 1.5.02, 57). This type of investigation was programmed for every week of the term and the evaluations of students’ progress included:

- Week 2 - “We did facts of 5 this week. Many children are struggling with the patterns” (Program Y2 T2 2002, 77).
- Week 4 - “Basic facts investigation of 7 this week. The children are improving in their understanding of patterns” (Program Y2 T2 2002, 135).
- Week 5 – “Whole class exploration of basic facts was good” (Program Y2 T2 2002, 162).
- Week 7 – “A substantial part of the class understood doubles, but had difficulty identifying a ‘near double’ in their basic fact practice (only about six children could)” (Program Y2 T2 2002, 237).
- Week 9 – Students were able to use and verbalise their mental computation strategies learnt through the basic fact investigations to solve non-routine problems (Program Y2 T2 2002, 317; Video-notes 27.6.02, 36, 38).

Confidence in my teaching

Awareness of my own lack of experience in both content and assessing student abilities is evident this term. In the first lesson of the term I taught content that was more difficult than that specified in the Syllabus or textbook (Video-notes 1.5.02; Program Y2 T2 2002, 54). Interestingly I commented that it was “a little too difficult” in my lesson evaluation (Program Y2 T2 2002, 54), but in the subsequent analysis of this lesson from video-tapes, I realised that the content was appropriate to Money 5 and not to the programmed Money 2 and 3 units. I subsequently became aware that, in not focusing on the main idea from the Syllabus I had missed the point in a few lessons prior to the completion of my program in Week 4 (Diary Y2 T2 2002, 43). In Week 9 I found the content of a Time lesson too easy for the children and wondered if I had missed something that I should have been teaching. I decided that I needed to look at resources to provide more challenging work in future lessons (Program Y2 T2 2002, 299-300).

In Week 5 I was observed by my supervisor as part of the regular practice of the school. Interestingly, my main concern going into the lesson was student behaviour and management (Diary Y2 T2 2002, 50) and while the feedback was very positive, the suggestion was made that I could be ‘warmer’ in my responses to the children (Diary Y2 T2 2002, 52). The response to my lesson was pleasing and I felt it had gone smoothly. I described it as “practical but not very creative...it was safe” (Diary Y2 T2 2002, 54). In reflecting on this now, I find my view of it being ‘safe’ interesting in light of the behaviour management issues that I normally avoided by having students work in pairs rather than groups. The notion of a ‘safe’ lesson here refers to the choice of lesson rather than the way it was structured. No chances were taken by teaching a lesson that focused on non-routine problems; I would risk no blank stares from the students if I could not adequately explain what they needed to do and no criticisms of my early efforts in changing my approach. The lesson was engaging in terms of being ‘hands-on’ and while I worked hard at behaviour management throughout the lesson, I controlled the behaviour of the class well.

At the end of Week 3 I reflected on the four parent/teacher interviews conducted that week. I was generally happy with how they had gone, with the exception of one where I felt my comments had displeased one mother. She had a misconception about how well her son had gone in mathematics in the previous year and thought that he was in the top mathematics group. He was claiming to be bored because the work in mathematics was too easy for him and he wanted extra homework. However, my perception was quite different. He struggled to finish work other students had completed, often looked puzzled in class discussions and I would have informally assessed his performance somewhere in the middle toward the bottom end of this middle group of the cohort. While I said none of this, I did explain that I was teaching the middle mathematics group and that in lessons her son did not appear to be finding the work too easy (Diary Y2 T2 2002, 9). I made some suggestions for additional homework, but I was aware that she was disappointed that her son was not in the top mathematics group and was not confident in my observations.

In the following week I had an interview with my supervisor where she advised me two parents had spoken to classroom teachers about their children having problems with mathematics groups. Both the students had been evidencing behaviour problems in class. One was very disruptive, the other difficult to engage in classroom activities. My reflections in the diary talk through their behaviours and the possible causes of their unhappiness. Interestingly, both situations resolved quickly, one prior to the interview as a result of following through with discipline and the other after talking to the child (Diary Y2 T2 2002, 13-20). Interestingly, my reflections do not record my emotions following these complaints, only the possible causes of the students' problems, explanations which served to protect my perceptions of myself as a caring teacher. However, my reflections on that time now, renew feelings of vulnerability I felt in being perceived in a harsh light.

Several comments are made this term regarding satisfaction with my teaching and/or progress in my teaching.

- In the program I noted that the first real attempt at introducing non-routine problems was excellent and the children's responses were very enthusiastic (Program Y2 T2 2002, 110).
- In my notes on the first video-taped lesson, I recorded satisfaction that my manner remained calm and cool despite feeling frustrated and pressured by some students' inappropriate behaviour (Video-notes 1.5.02, 56).
- In the lesson taped at the end of term:
  - I was pleased with the variety and pace of the lesson, feeling it was engaging and interesting (Video-notes 27.6.02, 48).
  - I was satisfied with my progress towards developing a mathematics culture that valued thinking over getting right answers by introducing the notion of putting on 'maths joggers and tracksuits' to get ready to complete the daily speed test, reinforcing the notion that speed tests were not competitions but training times (Video-notes 27.6.02, 45).

- I reflected that the students had become used to non-routine problems, no longer baulking at them or asking for more information (Video-notes 27.6.02, 49).
- Some progress in scaffolding worthwhile discussions had also been made (Video-notes 27.6.02, 51).

Discussion

While discussion was not my stated focus this term, developing a discourse community that not only did mathematics but talked about doing mathematics and talked about talking about mathematics, in line with the classes described in the Purdue Project (Cobb et al., 1993), was one of the long term goals I had in mind when teaching. In accordance with this I had worked at establishing rules for discussion times, as a regular part of class time, as seen in both recorded lessons (Video-notes 1.5.02, 29; Video-notes 27.6.02, 32; Program Y2 T2 2002, 316) and followed this up with positive and negative reinforcement for working within or breaking these rules (Video-notes 27.6.02, 34, 36, 38; Program Y2 T2 2002, 318).

Efforts to overcome my natural patterns of teacher behaviour, where the teacher is the arbiter of right and wrong answers, established in my previous experiences as a student, emerge from the data. At the beginning of the term the focus of student sharing time was the verbalising of my computational strategies in checking their additions and declaring their solutions right or wrong (Video-notes 1.5.02, 37, 41). However, the provision of non-routine and multi-solution problems and investigations assisted in shifting from this approach towards a focus on student thinking. In Week 5 I recorded in my program evaluation: “The children had lots of different answers and got the mathematics thinking right. They wrote their responses on the board (working in pairs) and checked each other's results...talking about everyone's answer as being ‘right’” (Program Y2 T2 2002, 165). At the end of the term discussion was focused on students sharing solutions, checking each others’ solutions and sharing how they worked out if a solution was correct or not (Video-notes 27.6.02, 34, 36, 38). I concluded in my reflection on this lesson that “I was quite happy with the end of the lesson in terms of sharing solutions. I think it was properly closed even though not all children listened or cooperated. I am improving in this area, on getting children to verbalise their thinking strategies and I am remembering to do that rather than just getting their solutions and declaring they are right or wrong” (Video-notes 27.6.02, 51).

While improvements in discussion times were evident by the end of the term, many students still “thought listening to others was an opportunity to finish off their own solutions or play” (Program Y2 T2 2002, 318). Students needed “more experiences and a lot of structure, firmly enforced” (Program Y2 T2 2002, 324).

In Week 8 in my program evaluation I noted that more time was needed at the end of lessons to allow for appropriate discussion and reflection (Program Y2 T2 2002, 264, 267). In my reflection at the end of the term I decided that this would be the focus of my teaching in Term 3. “I need to allow more time for tying things together; sharing answers; justifying solutions [and] sharing strategies. This will be my next focus for Term 3” (Program Y2 T2 2002, 325).

Group work

The development of group work was not a focus of my teaching this term and it was only used a few times (Program Y2 T2 2002, 170, 211, 259-264, 267). While my focus for change was on the introduction of non-routine problems, I felt pair work would provide some opportunity for the social construction of knowledge without the added difficulties of behaviour management that group work presented. Pair work went quite well, although a few students had problems working with others (Program Y2 T2 2002, 323; Video-notes 27.6.02, 28).

In lessons where group and pair work were utilised, time was usually spent making the expectations for appropriate behaviour explicit. This was seen in the second video-taped lesson where “I remind[ed] the students of how we work in pairs: sharing, doing our best work, being sensible [and] agreeing on a solution together” (Video-notes 27.6.02, 24; Program Y2 T2 2002, 311-315). This was repeated and followed up with a reward for the best pair work (Video-notes 27.6.02, 24).

Interestingly, in the previously mentioned conversation with Bobbie about the difficulties in implementing a problem solving and investigational approach to mathematics, Sidney (a very experienced Stage 1 teacher) joined the conversation and agreed with Bobbie that establishing group work was the biggest constraint. Time spent on establishing group work would be time not spent teaching mathematics. I recorded: “I suggested a ‘whole school’ approach [to group work] and they smiled but made no response” (Diary Y2 T2 2002, 91).

Active learning

As in Term 1 nearly all of the mathematics activities provided in Term 2 would be classified as encouraging active learning and many would be suitable only for encouraging the elements of lower-order thinking. “Lower order thinking is essential to build the foundations of understanding” (NSW Department of Education and Training, 2003a, p. 19) and much of the Syllabus content for this Stage could be categorised as establishing the foundations of mathematics. In many of the programmed activities (Program Y2 T2 2002, 88, 89, 124, 139, 145, 152, 186, 219, 249) students were required to practise procedural routines or to “recall information, define, describe, identify, list, reproduce, or state given content knowledge” as outlined in the support documents for the NSW model of pedagogy as producing lower-order thinking (NSW Department of Education and Training, 2003a, p. 18).

However, non-routine and multi-solution problems and investigations had been provided regularly throughout this term (Program Y2 T2 2002, 45, 110, 140, 165, 238, 310) and students were being asked to justify their responses, recommendations made in the NSW model of pedagogy support documents to encourage higher-order thinking (NSW Department of Education and Training, 2003a).

Mathematics resources

The use of manipulative materials is as important in this term as in Term 1. Again they are listed for every lesson in Term 2, always as an intention of programming and sometimes in evaluating the lessons. They were programmed for a variety of uses including:

- investigations or solving problems (Program Y2 T2 2002, 40, 42, 57, 59, 64-65, 88, 89, 93-95, 115, 120, 123-124, 143, 148, 153, 174, 178, 182, 186, 214, 219, 220, 226, 245, 249, 255, 270, 276, 286);
- to model mathematical concepts (Program Y2 T2 2002, 62);
- to scaffold the introduction and development of written forms of mathematical activities (Program Y2 T2 2002, 125); and
- to play mathematical games (Program Y2 T2 2002, 61-62, 276).

Program evaluations included:

- their effectiveness (Program Y2 T2 2002, 54, 238-239, 264, 265);
- difficulties in locating appropriate resources (Program Y2 T2 2002, 112);
- the need to make them (Program Y2 T2 2002, 79, 164, 171); and
- observations of how students used them and how these indicated their understanding (Program Y2 T2 2002, 137, 168, 170, 305, 317).

Behaviour management

Behaviour management did not have the same priority it had in Term 1 in my diary entries. Statements refer to behaviour management incidents to explain feedback from parent/teacher interviews (Diary Y2 T2 2002, 13-20) and references are made to inappropriate behaviour (Video-notes 27.6.02, 4, 6, 10, 20). Guidelines for behaviour are explicated, generally (Video-notes 1.5.02, 17) and specifically in relationship to group work and discussion (Video-notes 1.5.02, 33, 37; Video-notes 27.6.02, 8, 24, 32, 40; Program Y2 T2 2002, 311-316, 324).

Teacher/student relationships

There are three references to the relationships I had built with the students this term. The first is a positive reflection on the atmosphere in the classroom in the lesson of 1.5.02 (Video-notes 1.5.02, 60). The other two refer to the comments of parents, at parent/teacher interviews with the classroom teachers, concerning two children's dislike of mathematics groups (Diary Y2 T2 2002, 13-16, 18-20). Both problems were resolved satisfactorily and there were no further difficulties.

Lesson 27th June, 2002

Table 17 Year 2 27.6.02 - Coding sheet Dimension 1

Year 2 27.6.02 - Coding sheet Dimension 1 -Intellectual Quality					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
1.Deep knowledge	Addition was the key concept with the development of related mental addition strategies and use of manipulatives to support understanding of the concept. This focus was maintained throughout the lesson, though the textbook was a superficial way of focusing on the concept.	4	Content	There was a big idea focus on addition combinations to 20 which fitted within the Syllabus Key Ideas of Addition 4 and 5 "use concrete materials to build addition facts to 20", "use numeral and symbol cards to record addition facts to 20" and "recall basic addition facts to 20" (1989, pp. 214-215). Although the textbook was not ideal, the focus of the lesson was on addition and the strategies that support it.	5
			Explicit focus	The focus of the lesson was not spelt out, though it was mentioned (by me) when a student talked about putting a substraction symbol instead of an addition symbol in the textbook.	3
2.Deep understanding	A deep understanding of mental strategies was shown in the discussions by some students (only a few had the chance to share this). All students were able to offer a solution to the multi-solution problem.	3	Teaching for conceptual understanding	A good mix of activities was used in the lesson to develop a conceptual understanding of addition, strategies to work out addition problems and the addition facts to 20. Conceptual understanding was promoted when children needed to work out an addition solution and	4

Year 2 27.6.02 - Coding sheet Dimension 1 -Intellectual Quality					
4.Higher-order thinking	In the multi-solution question all students were able to work out what the problem required and find at least one solution. Some were able to think about their thinking, recognise the strategies they had used and express that to the class (not many had that opportunity in this lesson).	3		be ready to show it to the class. The class needed to be able to make a judgement on whether the answer was appropriate to the problem and be ready to explain how they knew that. The text page was largely a practice session of adding two numbers together, in 3 different formats (horizontal, vertical and grids) and manipulatives were available to support the children in this.	
3.Problematic knowledge	Differing solutions and strategies were encouraged and accepted – but the activities were not open to differing interpretations.	3	Problem solving	Multi-solution questions about balls then children. They were ‘good’ questions, though in the context of an addition lesson, following a page of practice questions, the children were ready to use addition strategies, though subtraction would have also achieved an appropriate solution, subtraction was not described to get a solution. This, however, was only one third of the lesson. The rest was practice.	4
5.Metalanguage	Metalanguage was used but not explained, all of the associated terms had been described before – nothing new to this lesson	2	Discussion	Sharing of solutions went quite well, though a very limited number were able to contribute.	3
			Written work	The written work was routine practice.	1
6.Substantive communication	The discussion where children explained their strategies was worthwhile, more so than the sharing of solutions. Children also had opportunities in their pairs to explain to each other, they were required to agree on their solutions. Again it was hard to monitor because of the limited time for children to share.	3	Student reflection	For those explaining and those listening and offering an explanation, reflection was evident. All children knew that they might be called on to participate, so they may all have been reflecting, but not enough children had the opportunity (and this was the norm in class discussions).	3

Table 18 Year 2 27.6.02 - Coding sheet Dimension 2

Year 2 27.6.02 - Coding sheet Dimension 2 –Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	For behaviour. For explaining their solutions. For group work.	4			
8.Engagement	Most children were on task, even when doing textbook. Children were hard to keep on task when listening to others' explanations.	3	Motivation	The variety of activities was appropriate although the textbook was not highly motivating, particularly for struggling students (who find too many questions on a page daunting), although some students liked it. The use of manipulative materials was helpful as a motivator. Most children enjoyed getting their own solutions. More time for discussion and sharing would have been good. Less time on practice sets in the textbook would have been good.	3
			Mathematical resources	The manipulative materials, Unifix cubes, were appropriate and while students did not need to use them to solve problems they were required to use them to model their solutions. Some students used more abstract approaches to working out their solutions and others preferred to use fingers to support their mental strategies. Number puzzles were available for early finishers. These were not related to the content of this lesson but were relevant in supporting the development of their understanding of number.	5
9.High expectations	All children expected to provide a solution. But not all of the lesson was challenging for all children.	4	High expectations of behaviour	Guidelines are communicated and evidenced in the behaviour of many students most of the time. Unacceptable behaviours are usually dealt with consistently and appropriately.	4
			Risk taking	Children appeared comfortable sharing their solutions. Several children volunteered to do this.	4

Year 2 27.6.02 - Coding sheet Dimension 2 –Quality learning environment					
10.Social support	Support was provided when asked for from the teacher. Support was offered by the teacher when not asked for. Scaffolding of their work was provided.	3	Social organisation	Textbook work was done individually. Pair work was being scaffolded as the children were not very experienced in it. The children worked in pairs on puzzles. The children worked in pairs on problems and presenting solutions. Quite a few students were having difficulty working together.	3
			Teacher's relationships	I look severe (I think I was unwell). I know I was very aware of the video and I look more relaxed at the end of the lesson. I appear helpful and supportive, and most children seemed comfortable and willing to ask for help.	4
11.Students' self-regulation	Some students were unsettled to start with, two children were spitting. Many students worked well without reminders, demonstrating autonomy and initiative in regulating their own behaviour most of the time. A handful of students needed repeated reminders to finish their work, usually the ones that struggled with textbook pages of multiple problems. Many finished their textbook work in a timely manner and came out to join in puzzles. However, a lot of the children had difficulty listening to other students when they were explaining their solutions.	2	Student autonomy	Opportunities were given, in the multi-solution problems, for students to make decisions and share those with their partner and the whole class. The practice and drill activities were based on students' conceptual understanding. Many students worked well on finding solutions to the multi-solution problem using Unifix cubes although a large number struggled in keeping on-task in the discussion.	3
12.Student direction	Students' choices were fairly limited but included the choice of whether or not to use Unifix cubes to solve textbook problems. They did not have a choice when modelling their solutions for the multi-solution problem. They were free to use any strategies for solving textbook problems. They were free to determine their own solutions for the multi-solution problem.	3	Problem solving & resources	The children had the choice of whether or not to use mathematical resources or not in the textbook work, and there was no stigma attached to using resources. However, the choices did not include a variety of manipulative materials, though some students used their fingers. Students were able to utilise their own strategies for solving both textbook and multi-solution problems.	3

Table 19 Year 2 27.6.02 - Coding sheet Dimension 3

Year 2 27.6.02 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	Background knowledge was evident in students' explanations e.g. use of doubles or near doubles to add numbers together. Lock in big number and count on etc. Explicit connections to previous addition lessons and strategies were made in context but not drawn out for those children who might struggle to make them. No out of school connections to background knowledge.	3	Building on prior knowledge	The whole lesson was based on previous work on addition and computation strategies, as well as investigations on basic addition facts. All children had been a part of this, though with differing degrees of conceptual understanding.	4
14.Cultural knowledge	N/A	1			
15.Knowledge integration	Not evident.	1	Teaching for the transfer of knowledge	Several meaningful connections were made between addition and the process or strategies used to work out an addition solution.	4
16.Inclusivity	Girls were determined as the best couple in pair work with another 2 couples of girls mentioned for their great work together. Boys were rewarded throughout the lesson for behaviour and work. Two girl couples showed their solutions, while only one boy couple shared theirs.	4			
17.Connectedness	Not really explored. The multi-solution problems had some connections to real life situations.	1			
18.Narrative	Two word problems had narrative involved. They were involved in the substance of the lesson, but only trivially used.	2			

Reflection on the lesson of 27th June 2002

A noticeable change was evident, since the first video-taped lesson at the beginning of this term, in the expectations of students in regard to understanding the nature of non-routine questions and sharing their thinking as well as their answers. While this lesson did not include a basic fact investigation, where students were becoming increasingly comfortable with finding patterns and verbalising their strategies and thinking, the benefits of these investigations were evident in student responses to the non-routine problems, where the strategies and thinking used in basic fact investigations were transferred to their explanations and justifications for their solutions to non-routine problems. The didactical contract, regarding our expectations of each other as students and teacher with regard to this 'new' approach to our mathematics lessons, had been established. The most notable area for improvement in pedagogy was the need to conduct more worthwhile and inclusive classroom discussions.

Action Research focus

The action research focus for this term was the introduction of non-routine problems as a regular part of my lessons and the progress of this has already been detailed. At the end of Term 2 the decision was made to continue providing non-routine problems as a regular part of my teaching. While I would continue efforts to improve pair and group work, the focus of change for the next term would be the development of my teaching in improving lesson closure. I reflected that I "want to plan for a less packed lesson making time for tying things together, sharing solutions and strategies" (Diary Y2 T2 2002, 89).

Term 3

A change of circumstances

In the second week of Term 3, I reflected positively on my experiences teaching mathematics, feeling satisfied with the developments in my teaching (Diary Y2 T3 2002, 2). However, meeting on a semi-regular basis with other novice teachers of primary school mathematics, I had become increasingly aware that my experiences teaching part-time, and only teaching mathematics, were inadequate in giving me a picture of the experiences of teaching primary school mathematics as a classroom teacher, responsible for teaching across all KLAs.

The conversation I recorded with Bobbie and Sidney at the end of Term 2 (Diary Y2 T2 2002, 91), regarding the differences in the way we were encouraged to teach at university and the reality of teaching in schools, left me with a sense that I needed “to get a more realistic perception by teaching full-time across all KLAs” (Diary Y2 T3 2002, 4). “To me it seems perfectly logical to approach the instigation of group work from a whole school perspective, especially when it is so strongly supported by research as essential for worthwhile learning. I know neither of them can instigate it from [a] whole school perspective [on their own], but if Sidney was doing it in Year 1 and Bobbie in Year 2 that's half the grades. There must be other things that stop them if they see the worth of it” (Diary Y2 T3 2002, 4). Hence, the decision was made to approach the school to teach full-time the following year and make enquiries elsewhere as well. I thought seriously about applying to other schools where I would not have to use the textbook, but I reasoned that novices go into schools and have to work within the existing culture and policies (Diary Y2 T3 2002, 47). I was eventually offered and accepted a full-time maternity leave position for the following year (Diary Y2 T3 2002, 21). Subsequently, I was asked if I could take it on for the last four weeks of Term 4 (The teacher’s baby being due at the end of November) (Diary Y2 T3 2002, 43-44).

Textbook use

Term 3 2002 again saw a strong focus on the use of the textbook (17 entries in the three different documents). The entries refer to the difficulties it caused, including the priority it was given over other activities when pressed for time (Program Y2 T3 2002, 80, 118), the time it took to complete and the difficulty it presented for some students (Program Y2 T3 2002, 80, 118), the difficulties children had in reading it, and the need to ensure that those with less advanced reading skills were not disadvantaged (Program Y2 T3 2002, 49).

The textbook was found to have inadequacies in the quantity of activities provided (Program Y2 T3 2002, 118, 121) and its specification of equipment which was not readily available (Program Y2 T3 2002, 121). Its layout was often daunting for struggling students, especially on addition and subtraction pages where multiple questions were presented in the form of webs and grids (Program Y2 T3 2002, 151; 271; Diary Y2 T3 2002, 26). The illustrations of clock faces for students to draw on were very small, requiring a level of accuracy and precision, that did not adequately accommodate the fine motor skills of most children in this age group (Kostelnik et al., 2007) (Program Y2 T3 2002, 240; Diary Y2 T3 2002, 33).

I reflected at the end of Week 5: "Some of the number pages in the textbook are very tedious, overwhelming in fact for some children. Only those who are very competent at adding (or subtracting) and work persistently, cope well. For a large part of the class they are daunting. I feel open-ended questions would get them doing the operation without the tedium, and the tedium of marking them. It's funny, the majority [of the children] can complete basic facts speed tests without baulking, but presented like they are in the text (e.g. spider webs of 10 or more facts) is too much" (Diary Y2 T3 2002, 26). At the end of the term: "I feel very constrained by the textbook, I don't always think it addresses the outcomes, it can be difficult for the children in terms of reading/fine motor skills/attention span. I would really like to have it as an option (Black Line Masters (BLM) of the pages, to use those you want)" (Diary Y2 T3 2002, 47).

Problem solving

In looking to improve my efforts at providing a problem solving and investigative approach to teaching mathematics I read Penny Skinner's (1990) book *What's my problem?*. At university I had previously seen a video-taped lesson of her classroom (NSW Department of School Education Western Region, 1989) and I was impressed by her approach to teaching infants and primary school mathematics. While I would have loved to emulate her approach I was surprised by the amount of time she had available for mathematics. In Week 3 I reflected: "She has the whole session between recess and lunch for mathematics. How does this work in terms of fitting in every other KLA? How does she do it? I wonder if she still does it?" (Diary Y2 T3 2002, 14). My own efforts to provide non-routine and multi-solution problems were restricted to 15-20 minutes of a one-hour lesson.

The provision of non-routine and multi-solution problems continued this term. This term these problems were decided on when programming and included in the program (Diary Y2 T3 2002, 18). They were provided for several lessons in the Number strand (Program Y2 T3 2002, 59-62, 161-163, 192-194, 219-221, 249-251; Video-notes 12.9.02, 15) and lesson evaluations included:

- Week 5: "The open-ended activity drew a variety of answers and we even looked at 100 and 10s, 1000 and 100s" (Program Y2 T3 2002, 178).
- Week 6: "Children have no problem with the concept of a 'fair' share. The open-ended activity produced all possible answers and children are not baulking at how to approach them any more" (Program Y2 T3 2002, 209).
- Week 7: "Students completed open-ended activity in pairs. They are comfortable with this type of question now. They are still having trouble with number sentences for multiplication e.g. 1 x 4 = 5" (Program Y2 T3 2002, 237).
- End of term: "As a class we have also come a long way in knowing expectations of behaviour, knowing what to do with non-routine questions and sharing our thinking. This has had benefits in timeliness as well as the obvious benefits" (Program Y2 T3 2002, 332).

Investigations

This term saw the continuation of investigations in all strands including Space (Program Y2 T3 2002, 139, 169, 293), Measurement (Program Y2 T3 2002, 70-71, 102, 198, 288) and Number (Program Y2 T3 2002, 39, 55, 90, 126, 156, 183, 215, 244, 276, 311).

The investigations to develop mental computation skills, to support the daily basic facts speed tests, emerged from the data as very important this term. They became a part of the classroom routine with children finding patterns increasingly easy to identify, many becoming quite competent at verbalising their mental computation strategies. In Week 5 I reflected “The investigations are going well. The children know what is expected of them now and they complete the investigation quickly. We write up their findings (I used to ask for facts, write them up, we’d sort them and discuss how we might remember them. Now they sort them by putting up the next fact in order). They are now doing a great job of verbalising why we don't have to remember both 7 + 4 = 11 and 4 + 7 = 11, we can lock the big number in our head, make tens, + 0, + 1, doubles or near doubles are easy. They have come a long way” (Diary Y2 T3 2002, 23-24).

In Week 8 the video-taped lesson of 12.9.02 shows 16 different students writing the number facts of 15 on the whiteboard in order. As a whole class activity different students suggested facts we could rub off the board, because they were duplicated or easy to remember or work out e.g. +0, +1, +10, doubles or near doubles. Students suggested strategies for working out other facts such as bridging 10 and counting on (Video-notes 12.9.02, 5-7). I commented in my lesson reflections: “The children know the routine well e.g. they knew exactly what to do with the number facts on the whiteboard” (Video-notes 12.9.02, 26).

Discussion

The action research focus this term was to improve lesson closure and discussion, to support student reflection and scaffold students’ construction of knowledge, in line with the literature on effective mathematics teaching (Clarke, 1997, 1999; Hicks, 1998).

- In Week 2 of Term 3 I commented “It is hard to set up a class culture of group work, so too is the culture of [listening attentively and] justifying [our] answers to the class and verbalising mathematics thinking, I have found it hard in the restricted time I have” (Diary Y2 T3 2002, 4).
- In Week 3 I said “I have been focusing on leaving more time at the end of the lesson for drawing things together. This is working in terms of finishing on time and me focusing on anything that needs addressing

- The discussions of number fact investigations had improved considerably and I noted in Week 5 that students doing a "great job of verbalising" patterns and computational strategies (Diary Y2 T3 2002, 23-24).
- In the video-taped lesson notes in Week 8, discussion associated with the investigation of the number facts of 15 went very well. Students were used to the now regular routine and could identify patterns and verbalise mental computation strategies for working out solutions (Video-notes 12.9.02, 7, 26). However, discussion at the end of the problem solving session still saw students unsettled and distracted rather than listening to other students' solutions (Video-notes 12.9.02, 21, 30).
- In my reflection on this lesson I noted "Watching myself I am more aware of my 'teacher focused' teaching than when I am doing it. I find it hard to let them 'discover' or 'justify' without taking over. I need to work on this" (Video-notes 12.9.02, 27).

I concluded at the end of the term that my planning for more effective closure to the lessons, including discussion, had not affected my programming. Less time was allotted to the other activities in the lesson to allow time for discussion/closure. I reflected: "The quality of the discussion was varied and I still find it hard not to be the one who does most of the talking. This still happens a lot. I guess I am keen to make sure the focus of the lesson is clearly drawn out and this does not always happen via the children. I think I would need another lesson structure with less in it to really allow a culture of sharing insights and justifying solutions to develop. But I have made a start" (Program Y2 T3 2002, 330). In my diary I concluded "I am quite happy with my progress in terms of focusing on student thinking, offering non-routine questions, trying to tie the lesson up with class discussion and utilising group work" (Diary Y2 T3 2002, 47).

Group work

Group work was used more regularly this term (Program Y2 T3 2002, 67-71, 85, 102, 189-190, 198-199, 212, 287-288, 293, 306) and pair work continued to be frequently used (Program Y2 T3 2002, 51-52, 237, 249) though not always noted in the program. Only two comments were made in the term as to how group work was progressing:

- Week 3: "The activity was abbreviated and done in four groups. Some groups worked well together, some still have difficulty focusing on instructions and sharing activities" (Program Y2 T3 2002, 121).
- Week 9: "Children enjoyed this and worked well in groups, completing different tasks and comparing results. We discussed possible reasons for the differences we found e.g. different sized shoes for measuring" (Program Y2 T3 2002, 306).

At the end of term I reflected: "I am quite happy with my progress in terms of focusing on student thinking, offering non-routine questions, trying to tie the lesson up with class discussion and utilising group work" (Diary Y2 T3 2002, 47).

Classroom mathematics culture

While some progress had been made in establishing more effective group work and discussion times (Diary Y2 T3 2002, 47), they fell short of those reported in the mathematics research literature and my long term goals for mathematics teaching. However, a worthwhile classroom culture had been developing from the routine of basic facts investigations and the provision of non-routine or multi-solution problems.

Basic facts investigations and non-routine problems continued to be a regular feature of mathematics lessons this term and became established as part of our class routine. The introduction of non-routine problems and investigations had seen a change in the didactical contract (Brousseau, 1984, 1997) underpinning mathematics lessons. Students now expected to undertake basic facts investigations in groups or pairs and share their findings with the class. Mathematics lessons regularly saw students finding and demonstrating patterns, identifying and verbalising mental computation strategies and analysing why some facts were easier to remember or work out than others (Program Y2 T3 2002, 210, 331; Video-notes 12.9.02, 5-7). Students engaged in these investigations and discussion times enthusiastically, sharing and listening attentively to other students. While students had a range of conceptual understandings and abilities to verbalise their thinking (Program Y2 T3 2002, 210), all students were comfortable with contributing to both the investigations and discussions. At the end of the term I reflected: "We have developed a routine; they know what they are doing and do it quickly and efficiently now. They have come a long way in this" (Program Y2 T3 2002, 331).

Non-routine and multi-solution problems had also become a regular feature of Number lessons (Program Y2 T3 2002, 59-62, 161-163, 192-194, 219-221, 249-251; Video-notes 12.9.02, 15;) and students approached them with the expectation that they would be able to work out a solution, often finding several solutions and as a class finding all possible solutions (Program Y2 T3 2002, 209). They were ready to share their solutions and knew how they were to behave in sharing times (Program Y2 T3 2002, 332), although they still had considerable trouble listening to others (Video-notes 12.9.02, 21).

Active learning

As in Terms 1 and 2 nearly all of the mathematics activities provided in Term 3 would be classified as encouraging active learning. All activities, provided outside of the textbook work in the Number strand this term, were non-routine or multi-solution problems (Program Y2 T3 2002, 59, 62, 131, 133, 161, 163, 191, 193-194, 219, 221, 249, 251) and investigations (Program Y2 T3 2002, 55, 90, 126, 156, 183, 215, 244, 276, 311). Discussions where students were asked to justify their solutions were conducted as part of these lessons and students were being offered opportunities to regularly engage in elements of higher-order thinking.

Assessment

Assessment for reporting had been burdensome in Term 2 and, therefore, I tried to make a start to avoid the same difficulties in Term 4 (Program Y2 T3 2002, 333). However, it continued to be difficult to accomplish in the day-to-day running of the lesson and at the end of Week 9 I reflected: "I have been trying to get more of a handle on assessment this term, noting improvements when I see them, but this I find almost impossible to do while teaching, helping, maintaining behaviour management and all the other things that are happening. If I walk around with my assessment sheet I feel I'm not as available to help as I should be, this sort of multi-tasking is beyond me" (Diary Y2 T3 2002, 41).

Mathematics resources

The use of manipulative materials continues to be important in this term as can be seen in their use in all lessons, the different ways they were utilised and the importance placed on their provision, spending hours in making them when I could not locate suitable resources.

They were used:

- In investigations or solving problems (Program Y2 T3 2002, 51-52, 55, 59, 62, 70-71, 85, 90, 102, 126, 131, 133, 137-139, 156, 161, 163, 169-170, 183, 190, 198-199, 215, 219, 221, 226, 227, 244, 249, 251, 256-258, 276, 280-282, 288, 294-295, 311, 315, 320-322);
- To model mathematical concepts (Program Y2 T3 2002, 226);
- To scaffold the introduction and development of written forms of mathematical activities (Program Y2 T3 2002, 60, 219, 249); and
- To play mathematical games (Program Y2 T3 2002, 96, 227, 248).

Program evaluations included;

- Their effectiveness (Program Y2 T3 2002, 177, 240; Diary Y2 T3 2002, 24);
- Difficulties in locating appropriate resources (Program Y2 T3 2002, 180; Diary Y2 T3 2002, 31);

- The need to make them (Program Y2 T3 2002, 177, 240; Diary Y2 T3 2002, 10, 29, 33); and
- Observations of how students used them and how these indicated their understanding (Program Y2 T3 2002, 177, 306).

Themes

In Week 8, in an evaluation of a subtraction lesson which focused on the relationship between addition and subtraction, I recorded an incident which triggered the beginning of a common theme in my mathematics teaching. “Matisse twigged to the pattern, he could see the relationship between addition and subtraction. This gave me the opportunity to talk about patterns and mathematics being about patterns. Matisse called it a ‘trick’ and we talked about patterns, not tricks and "maths makes sense" (Program Y2 T3 2002, 271). We had regularly talked about the patterns that could be seen in our number fact investigations (Program Y2 T2 2002, 77, 135; Program Y2 T3 2002, 210, 331; Diary Y2 T3 2002, 23-24; Video-notes 1.5.02, 57; Video-notes 12.9.02, 5-7, 26) and subsequent to this lesson “maths makes sense” became a regular reminder to the children to check if their solutions made sense.

Behaviour management

Behaviour management did not emerge from the data as having great importance or priority this term, though some students continued to struggle with appropriate behaviour in group work (Program Y2 T3 2002, 121) and discussions (Video-notes 12.9.02, 21, 30). I reflected at the end of the term: “As a class we have...come a long way in knowing expectations of behaviour, knowing what to do with non-routine questions and sharing our thinking. This has had benefits in timeliness as well as the obvious benefits” (Program Y2 T3 2002, 332).

Lesson 12th September, 2002

Table 20 Year 2 12.9.02 - Coding sheet Dimension 1

Year 2 12.9.02 - Coding sheet Dimension 1 – Intellectual Quality					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
1.Deep knowledge	Focus was on the relationship between addition and subtraction in terms of comparative subtraction and this was sustained (even in the speed test). The textbook pictures and associated number sentences were only a superficial focus. The lack of discussion to draw out student thinking made the investigation a more superficial focus than it could have been.	3	Content	The big idea of the lesson was to do with comparative subtraction and the relationship between + and – which fits within Subtraction 4 objectives (1989, p. 224) "use symbols for subtraction, addition and equality to represent the comparison of two groups" and "addition may be an appropriate strategy for solving a subtraction problem". The focus was more on the relationship than addition as a means of solving a subtraction problem, and this would have been worthwhile to draw out. The focus on the relationship between + and - was sustained (though it could have been a deeper focus without the textbook and if the discussion had been more focused on student thinking).	4
			Explicit focus	The focus on the relationship between + and – was made explicit in the textbook introduction and in the introduction to the multi-solution problem, however, I think it could have been more clearly explained in the multi-solution problem, though it was drawn out clearly in the concluding discussion. The use of addition to solve subtraction problems was mentioned but superficially.	4
2.Deep understanding	Understanding was variable with some students clearly understanding the relationship and other still struggling.	3	Teaching for conceptual understanding	The lesson included a mix of activities which were structured to enable the development of conceptual thinking as well as give students experience in answering textbook type questions in exam conditions. The non-routine problem was easy for students when they understood it. The associated addition number sentence was easily done, but the subtraction number sentence was difficult for some. The previous class work using the textbook and the set grade test had shown that a large group of children had not made the connection between + and -. This lesson still evidenced	4
4.Higher-order thinking	The aim of the lesson was to build a conceptual understanding of the relationship between + and -. Students were generally required to make that connection to present their solutions.	4			

Year 2 12.9.02 - Coding sheet Dimension 1 – Intellectual Quality

				that some students had not made the connection. One of the students talked about seeing the trick in the textbook work where he (and others) was looking to complete a procedure or pattern to answer the questions. The limitation of the textbook in many topics leads to this procedural approach and encourages students to be looking at problems in this way in their efforts to solve them.	
3.Problematic knowledge	The multi-solution problem challenges the students' ideas that mathematics is about one right answer.	4	Problem solving	The multi-solution problem was useful for building on prior knowledge of + and – and previous work with the relationship between the two operations but for some students the textbook work and the use of the cards to show an addition and subtraction number sentence associated to their solution was procedural.	4
5.Metalanguage	Language associated with addition and subtraction was used (not always mathematically correct usage) but not clarified.	2	Discussion	Too brief and not enough student explanation/demonstration. While this was a regular routine in this class by this time, it was very difficult to keep students on task and listening and reflecting on other students' explanations, hence it was seen by me as a training experience for them. The discussion did not focus on right or wrong solutions but it was not focused clearly enough on student thinking either.	4
			Written work	Textbook, whiteboard and use of number/symbol cards. The focus of the written work was not on student thinking, though the discussion following the work on the whiteboard was focused on this. This sequencing of number facts was the result of many months of investigating number facts, recognising patterns and making computation strategies explicit. Students were demonstrating substantial understanding in writing them up in the way they did.	3 Difficult to code
6.Substantive communication	Facts of 15 discussion was substantive communication with words and the whiteboard. The conclusion was more teacher-directed but it was important. In follow-up lessons the use of Unifix cubes at the same time as the teacher's instructions about number sentences would consolidate learning.	4			
			Student reflection	The use of Unifix cubes and cards to show the number sentences provided an opportunity to reflect on what students did to get their solutions. But this was not well	3

Year 2 12.9.02 - Coding sheet Dimension 1 – Intellectual Quality					
				scaffolded and there was not enough time given in discussion for the number sentences to be adequately talked about.	

Table 21 Year 2 12.9.02 - Coding sheet Dimension 2

Year 2 12.9.02 - Coding sheet Dimension 2 –Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	It was made clear what students needed to do, and at least one solution was required (more if time). The number sentences had to be connected to the problems students were doing and include an addition and subtraction sentence. Some students who were having trouble with this asked for assistance.	3			
8.Engagement	Engagement is widespread and the possibility of going on to Question 2 once they had finished Question 1 a, b, and c maintained students' interest. Most students were trying hard and on task most of the time until the discussion when some lost interest.	4	Motivation	The textbook questions were daunting for some students (a lot of subtraction questions in a small space seemed overwhelming), though some really enjoyed them. The variety and pace of the lesson was good and most children were engaged almost all the time.	4
			Mathematical resources	Resources were appropriate and plentiful. All students had a set of symbol and numeral cards and Unifix cubes. They were appropriately used to model their solutions or help with solving textbook problems, though the cards were procedurally used by some students.	4
9.High expectations	Most students participated in challenging work during most of the lesson. They were encouraged to keep trying if they experienced difficulties. All students found at least one solution (some finding more than one) to the multi-solution problem, nearly all produced an addition number sentence and most a related subtraction sentence (some with substantial help). Positive responses were given to many students.	4	High expectations of behaviour	Students evidenced high expectations of their behaviour in the main part of the lesson. Listening to others in discussion is a much more difficult task for them at their age, especially when this is not always interesting. Several students had difficulty listening to others and staying on-task. Clear expectations were expressed throughout this time but the difficulties persisted. I dealt with it by making the discussion brief, but the discussion of student thinking suffered because of this.	4

Year 2 12.9.02 - Coding sheet Dimension 2 –Quality learning environment					
			Risk taking	Most students were confident to contribute (even strugglers) – write on the whiteboard, show solutions, answer questions and ask for help (one student was slow to ask for help). Rules regarding appropriate behaviour in discussion time were made clear but not heeded by many by the end of the concluding discussion.	3
10.Social support	Social support was clearly positive, no negative comments, incorrect answers were dealt with kindly (either downplayed and/or revisited to scaffold and support self esteem). There was one general comment about some people's difficulty with the concept of the relationship between + and -, which might have been better given, but it was not specific to any child (many had struggled with it) and it was made to clarify the purpose of the lesson.	4	Social organisation	Whole class or individual work was utilised in this lesson. No group or pair work (this was not the norm). Although there were no set groups or pairs, several students helped each other.	2
			Teacher's relationships	Positive relationships with most students were evident. I was relaxed and smiling. Students generally asked for help, answered questions etc. I was supportive of strugglers, checking to see their progress. One child asked for help early in the multi-solution problem but did not ask for follow-up help with the number sentences.	4
11.Students' self-regulation	Most students worked well most of the time and completed their tasks where they could. Students had the opportunity to move forward in their textbook questions and did so if they had the time. Most needed no assistance in regulating their own behaviour except in the discussion at the end of the lesson.	4	Student autonomy	Practice and drill were based in a conceptual understanding of the basic facts up to 15. There was not enough opportunity to share their thinking but students worked well on their own solutions.	4
12.Student direction	There were some choices available for students in resources and in the multi-solution problem. However, most aspects of the lesson were directed by me.	3	Problem solving & resources	There were some choices available for students in resources and in the multi-solution problem. Resources were appropriate but the choices were very limited.	3

Table 22 Year 2 12.9.02 - Coding sheet Dimension 3

Year 2 12.9.02 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	Knowledge associated with previous lessons explicitly mentioned many times. There was repeated talk about students' mental calculation	3	Building on prior knowledge	Months of work on the addition and subtraction facts (we were up to 15 in this lesson) preceded this lesson. The way the students participated in the first	5

Year 2 12.9.02 - Coding sheet Dimension 3 – Significance					
	strategies and this was not simply related to school mathematics, although the uses of these strategies outside of school were not specifically mentioned.			part of the lesson evidenced much of that work and they were making clear connections with previously talked about strategies and patterns. The work on the connection with the relationship between + and – was linked to previous difficulties the children had with this and looking to support students' further development of this concept (this was why this was the main focus of the lesson rather than addition being a strategy to solve subtraction problems).	
14.Cultural knowledge	The knowledge associated with the scoring of a netball game was presumed, but a very minor focus of the lesson. This knowledge would not have been specific to the dominant culture.	2			
15.Knowledge integration	Relationship between Addition and Subtraction was clearly made.	3	Teaching for transfer of knowledge	Several meaningful links were made between the process and content in both the basic fact section of the lesson (their strategies were as important as their answers) and the subtraction problems (the use of Unifix cubes to model their solutions and the processes of both addition and subtraction).	4
16.Inclusivity	Most students were included in all ways, in particular two struggling students were part of the demonstration and discussion at the end of the lesson. However, one student asked a question near the end of the lesson which was crucial for him to complete the activity and there was now no time to do that.	4			
17.Connectedness	The multi-solution problem could have connections with real life, in fact a student asked if it was real. The connections were tenuous but useful.	2			
18.Narrative	In relation to the multi-solution problem narrative was used.	3			

Reflection on the lesson of 12th September 2002

The most notable aspect of this lesson in terms of improvement in my teaching was the evident success of the introduction of basic fact investigations. Through these investigations the students had developed a range of mental computation strategies, become considerably more adept at identifying patterns and were increasingly confident to share their thinking as well as their solutions. The development of these skills had seen an improvement in students' completion of basic fact speed tests and supported students in their abilities to identify their thinking when completing non-routine problems. The notion of "maths making sense" was drawn out of this lesson, an important moment in my thinking as a teacher. This comment became a central theme in my teaching for the remainder of the year and throughout 2003, where I regularly reminded students to check if their solutions made sense and not to simply follow procedures.

Action Research focus

The action research focus for this term was the improvement of lesson closure and discussion and this has already been detailed. At the end of the term I reflected: "I have tried to make a start on assessment for reporting to avoid the difficulties of last term. General assessment is also a difficulty (really knowing where the children are up to in their thinking). I need to focus on this next term" (Program Y2 T3 2002, 333).

Term 4

Week 6 Term 4 saw a shift from teaching the mathematics group part-time to teaching Mel's Year 2 class full-time, when she went on maternity leave.

Assessment

Assessment was an important focus of Term 4 as this was a reporting term. Responsibilities for reporting did not change as Mel completed the reports for her home class (Diary Y2 T4 2002, 2).

I was determined when the term started to assess as I taught, though I had found that difficult in the past (Diary Y2 T4 2002, 5). I tried to monitor students as they worked and to make anecdotal notes and while I was more efficient than in Term 2, I still spent a considerable amount of RFF time withdrawing students from regular lessons and setting up activities for the rest of the class so I could assess mathematics (Diary Y2 T4 2002, 24, 34). I commented "I find it really difficult to do, especially assessing specific outcomes that require watching a child complete a task and questioning him about what they found/did. I don't know how to do it as part of the regular routine. But I'm not alone - both the other Year 2 teachers did the same in all KLAs. Maybe there is a problem in the detail required in reporting. No doubt I will improve with practice but I think this one is a very long journey" (Program Y2 T4 2002, 238).

As in Term 2 I had difficulty with a few of the examination tasks being appropriate for assessing the outcomes (Program Y2 T4 2002, 123-124; Diary Y2 T4 2002, 19, 21). Assessment again highlighted for me the differences between what I was trying to develop in my mathematics teaching and the focus of the mathematics teaching of the other teachers. I have included the whole diary entry here for clarity: "Another assessment issue surfaced with a length task asking the children to measure the perimeter of a rectangle using shorts. I would have accepted a range of answers as satisfying this outcome (e.g. placing the shorts on the line, inside the line or outside the line), but we were only able to accept one answer (placing them inside the line and not counting those on the corners) as this gave the 'correct' answer. I don't think the outcome is assessing this level of accuracy (The outcome is "Measures perimeters using informal units") but rather the ability to identify a perimeter and use an informal unit with no gaps or overlaps to measure it. I'm afraid I would probably have gotten the answer incorrect (my immediate reaction was to place the shorts on the inside of the line, this gave an answer of four less shorts unless you count the corner ones twice). Apparently the exam question last year showed a rectangular shape with rounded corners and they found they had to accept a variety of answers and so they changed it for this year so that there was only one correct answer. Perhaps another type of unit might have been used that did not require that sort of discrimination. I know Bobbie prepared her class for the question by showing them how to use shorts to measure it and explained why they must measure from the outside and not count the corner shorts, my class did not get that explanation, so I guess I disadvantaged them, though I know a lot of them probably wouldn't have seen the point anyway. I've tried to work out whether my approach is too lax, whether it's me that has missed the point, or the other teachers. I guess I will always think it's them unless someone can make a case for it (I guess the case for it would be "this is the only answer that is really right") that I agree with. I tried to figure out what it is that annoys me about this sort of difference and I think it is that it highlights a fundamental difference in approaching the teaching of mathematics. I am trying to let go of my natural disposition to focus on mathematics being right and wrong and concentrate on the process and I feel that this approach is reinforcing this notion that mathematics is about getting the right answer. I think that the textbook focus also supports this notion. Well that feels better, that's off my chest!" (Diary Y2 T4 2002, 21).

Behaviour management

Behaviour management re-emerged this term as an issue. Inappropriate behaviour was a regular problem in the classroom when I commenced teaching full-time in Week 6. I commented: "There are about six children who are real handfuls - several I didn't have in my other class. So it has been like starting over with a new class, with children testing the boundaries, like they do with casuals" (Diary Y2 T4 2002, 29). Two students, in particular, continued to be troublesome throughout the remainder of the term and they were described as "hard work", one of them "exhausting" (Diary Y2 T4 2002, 37).

The issues with behaviour management affected mathematics lessons, with children being more unsettled in discussion times and transition times taking longer between activities (Diary Y2 T4 2002, 39). My teaching decisions were also influenced, as evidenced in my decision to organise the Volume and Capacity lesson as a student involved demonstration, rather than a 'hands-on' investigation as programmed. I commented "they are a new group and there are so many children with behavioural problems, I did not want to risk chaos" (Diary Y2 T4 2002, 31).

Classroom mathematics culture

The importance of routines in supporting the smooth running of a classroom and the maximising of learning opportunities became evident to me in the last weeks of this term. There were marked differences between teaching mathematics to the mathematics group at the beginning of the term and to the home class at the end of the term; "It made me realise how effective and established my routines had been with my previous class. This obviously takes time to establish with every new class, but it wasn't so obvious to me before this. These routines can be as varied as behaviour management, classroom structure, lesson structure, moving from one activity to another, what we do in basic facts investigations and non-routine problem solving. They all impact on the quality and efficacy of a lesson" (Program Y2 T4 2002, 240). "These are obviously things that develop over time and we haven't got the time" (Diary Y2 T4 2002, 39).

Mathematics resources

The use of manipulative materials continues to be important in this term. They were used in every lesson for:

- investigations or solving problems (Program Y2 T4 2002, 30, 42, 46-47, 66, 76, 81-82, 103, 127, 131, 136, 144, 149, 158, 161-163, 180, 194-195, 200, 214, 226); and
- to model mathematical concepts (Program Y2 T4 2002, 52, 53).

Program evaluations included:

- their effectiveness (Program Y2 T4 2002, 63, 124, 175, 177, 211, 235; Diary Y2 T4 2002, 39);
- difficulties in locating appropriate resources (Program Y2 T4 2002, 118, 146); and

- the inadequacy of the teaching space to accommodate safe water usage (Program Y2 T4 2002, 177; Diary Y2 T4 2002, 31).

Textbook use

Term 4 2002 saw less of a focus in my entries on the use of the textbook than previously (10 entries in the two different documents). The entries included descriptions of how the textbook was used (Program Y2 T4 2002, 39; 61), its inadequacy in teaching the main idea of a unit on Volume (Diary Y2 T4 2002, 11) and the effectiveness of the textbook over the use of grid paper in enabling turning around a point (Program Y2 T4 2002, 63).

I started teaching full-time in Week 6 of this term and reflected at the end of Week 8: “Mathematics lessons aren't as well organised and prepared for as they have been all year - the full-time load has already affected that. I find I am looking for equipment on the morning rather than having it organised two days in advance. Number lessons have been focused on the textbook pages with the provision of manipulatives e.g. Unifix cubes.” (Diary Y2 T4 2002, 39).

Confidence in my teaching

While confidence or lack of confidence in my teaching did not emerge strongly from the data this term, there were a few references to this factor. In Week 2 my lesson evaluations noted my uncertainty about a concept which had emerged in the lesson. I felt this uncertainty had led to an inaccurate presentation of the concept of rotating around a point (Program Y2 T4 2002, 63) and subsequently clarified the concept from the Syllabus and a mathematics dictionary (de Klerk, 1999)(Diary Y2 T4 2002, 8). However, it became an issue again in the yearly examination when the presentation of a question also showed a lack of understanding of the concept (Diary Y2 T4 2002, 19).

We have seen that In Week 4, following the yearly examination, I recorded my reflections on what I perceived as the inadequacies of an examination question on the measurement of perimeter. I felt my class had been disadvantaged in the examination because of my very different understanding of the outcome. Subsequently, I recorded my struggles to let go of my natural inclination to focus on right or wrong answers and to focus on the process rather than the product of students' efforts. This was exacerbated by the mandatory use of a textbook which reinforced this approach within the context of the other Year 2 teachers focusing on students' answers rather than their conceptual understanding (Diary Y2 T4 2002, 21).

In my reflections on the year I commented: "I have enjoyed [teaching] on the whole, despite the fact that I didn't often teach in the way I would like to (Diary Y2 T4 2002, 53). In ranking my development as a teacher of mathematics I felt I now had a very good understanding of Year 2 content (Diary Y2 T4 2002, 58).

Problem solving

Multi-solution or non-routine problems were provided for several lessons this term (Program Y2 T4 2002, 71, 153, 175), though not as frequently as in Terms 2 and 3 due to reporting, changes in my class and end of year activities. The multi-solution problem, provided prior to the change in class that occurred in Week 6, saw most students responding with confidence and many providing multiple solutions (Program Y2 T4 2002, 95). However, following my shift to teaching the Year 2 home class in Week 6 my evaluations included:

- Week 6: "Children went quite well at the activities using counters and Unifix cubes, but not as well in writing the equations. The open-ended question took a while for some students to work out" (Program Y2 T4 2002, 175).
- Week 8: "I have provided some open-ended questions and found the students I have not taught before finding them unusual" (Diary Y2 T4 2002, 39).

Investigations

This term saw the continuation of investigations of basic addition and subtraction facts to support daily speed tests until Week 5 (Program Y2 T4 2002, 30, 42; 66; 103; 127). I commented after the students had completed the investigation of the facts of 20: "The children have really improved, not just in their completion of speed tests but in their mental strategies for addition and subtraction, seeing patterns and talking about them" (Diary Y2 T4 2002, 26).

Investigations were also conducted in Space (Program Y2 T4 2002, 52-53, 81-82, 99, 224-226), Measurement (Program Y2 T4 2002, 75-76, 136; 146, 164, 194-195, 199-200) and Number (Program Y2 T4 2002, 106).

Active learning

As in Terms 1, 2 and 3 nearly all of the mathematical activities provided in Term 4 would be classified as encouraging active learning. Many would only provide for lower-order thinking, especially as this term saw less provision of non-routine and multi-solution problems (Program Y2 T4 2002, 71, 153, 175) and investigations (Program Y2 T4 2002, 30, 42; 66; 103; 127). This was due to the preparation for and administration of the yearly examination, 'hands-on' assessment (Diary Y2 T4 2002, 34), the completion of the number fact investigations up to 20 (Diary Y2 T4 2002, 26), the change of class that took place in Week 6 (Diary Y2 T4 2002, 39) and the end of school activities that took precedence over the normal routines (Diary Y2 T4 2002, 37).

Workload

Workload was mentioned twice this term in my diary entries. Firstly, in order to complete one-on-one assessment it was necessary to withdraw students from normal lessons in my RFF and to set up activities for the class to go on with while assessing individuals. This was a problem for the other two Grade teachers as well, Mel coming in on her maternity leave to take students out of class for assessment (Diary Y2 T4 2002, 34). Secondly, the shift to a full-time teaching load affected my organisation and preparedness for mathematics lessons; “I find I am looking for equipment on the morning rather than having it organised two days in advance” (Diary Y2 T4 2002, 39).

Action Research focus

The action research focus for this term was to be more efficient in assessing for reporting, endeavouring to do as much as possible as part of my lessons (Diary Y2 T4 2002, 5). I continued to struggle with this (Diary Y2 T4 2002, 24) and required extra time in my RFF, but it took a lot less extra time than it had in Term 2 (Diary Y2 T4 2002, 34). I concluded: “I have managed it more successfully [than in Term 2] but I still have a long way to go. I'm not the only one who had to withdraw children, Bobbie was doing it and Mel actually came in from her leave to do it. Poor thing, she had so much to do. She finished and went into labour - a baby boy! Anyway, reporting has finished - I had a few rewrites, but only a couple” (Diary Y2 T4 2002, 34).

My evaluation of the development of my teaching

At the end of the year, I drew on my diary and video-taped lessons and comparing my teaching with the characteristics of best teaching practice, gave myself a ranking out of ten based on my instinctive judgements about my development at the time (Diary Y2 T4 2002, 56-63).

“I have developed:

- useful behaviour management skills using both positive and negative reinforcement, but focusing on the positive, with Year 2 children (9);
- a safe risk taking environment where children feel safe to share their answers and thinking (8);
- my understanding of the content of Year 2 mathematics (9);
- my understanding of the possible ways Year 2 children will approach different aspects of mathematics and their mathematical thinking (6);
- a problem solving approach to enable Year 2 children to ‘discover’ the mathematics (6);
- a culture of “talking about doing mathematics” in this Year 2 class (6);

- a culture of participating cooperatively in a group to solve problems and present your solutions to others (6); and
- a culture where mathematics is not about getting ‘right’ answers but about the process of getting an answer (6)” (Diary Y2 T4 2002, 55-63).

CHAPTER SIX

Analysis and discussion of teaching mathematics in the second year

Introduction

This chapter is a continuation of data analysis focusing on the second year of teaching. Each term was analysed in terms of the factors and/or issues that emerged from the data, as well as the video-taped lesson analyses, an overview of which is presented in Table 23 (p. 188). Video-taped lessons analyses are placed to reflect where they occurred, in terms of timing, each term. The order of the issues discussed each term has some relationship to the importance they had, although some needed to be placed in close proximity to others as they were interrelated and often clarified each other. While the order, particularly of the important issues that emerged each term, has largely been determined by the number of times references occurred in the data and the nature of those references, some issues had significance in not being mentioned in the data and this too has been highlighted.

Table 23 Overview of the issues/problems 2003

Overview of the issues/problems emerging from the data in 2003			
Term 1 2003	**Term 2, 2003**	**Term 3, 2003**	**Term 4, 2003**
Workload	Workload	Workload	Workload
Confidence in my teaching	Students' upsets	Students' upsets	Students' upsets
Behaviour management	Assessment	Teacher/student relationships	Confidence in my teaching
Mathematics resources	Confidence in my teaching	Parent/teacher interactions	Problem solving and investigations
Textbook use	Medical/Family concerns	Safe environment	Mathematics resources
Active learning	Problem solving and investigations	Support	Textbook use
Problem solving and investigations	Mathematics resources	Confidence in my teaching	Discussion

Discussion	Active learning	Behaviour management	Assessment
Students' upsets	Behaviour management	Discussion	Behaviour management
Teacher/student relationships	Discussion	Assessment	Safe environment
Time constraints		Mathematics resources	Lesson 4.12.03
Themes		Textbook use	Action Research focus
Routine		Themes	
Support		Active learning	
Lesson 3.4.03		Problem solving and investigations	
Focus for improvement		Group work	
		Routine	
		Lesson 25.9.03	

In assembling the data for analysis, a decision was made to include details from my own organising diary as well as my teaching diary, program and video-taped lesson notes. I added the reasons for this inclusion in a postscript to my data in February 2006, which is included here for clarification:

- "Teaching full-time I felt my family, church, school board, education commitments as well as my own health and my daughter's health concerns were all factors needing consideration when analysing my teaching experiences...The first nine months of 2003 were quite a traumatic period for...our family. This did affect my emotional state, and while I feel it did not affect my teaching or teaching preparation, it no doubt affected my ability to cope with stress" (Diary Y4 T4 2003, 297-298).

Setting and Background: Continuation

After being offered a full-time maternity leave position at the end of 2002 for four weeks and for the 2003 school year, I commenced teaching full-time in Week 8 of Term 4, 2002. I attended an orientation evening at the school in this time, along with other teachers who were due to commence at the school in 2003. At this session we were given a tour of the school, provided with school policies and guidelines and introduced to executive staff.

At the commencement of 2003 the Stage 2 coordinator organised an informal gathering to enable the Stage 2 staff to get to know each other prior to commencing school. With the exception of the coordinator the other two staff members and myself were new to the school, one commencing in Term 4 of 2002, the other two of us commencing as full-time staff members in Term 1, 2003. The Stage 2 coordinator left the school in Term 2 and due to the inexperience of the teachers on the Stage, was replaced by a more experienced teacher from another Stage. This teacher did not join the Stage and continued as the Stage 2 coordinator for the remainder of the year.

In 2003 I commenced teaching primary school mathematics with a Year 4 class at the same independent school at which I had taught in 2002. I taught my home Year 4 class as their full-time teacher. At this school classes were ungraded, with the exception of Mathematics and English. These subjects were taught at the same time across the primary school to enable the movement of students, considered to be gifted in Mathematics and English, to join another grade for these subjects. The mathematics class I taught was considered to be the top ability group of the Year 4 cohort and included three Year 3 students who were accelerated for mathematics. Mathematics was taught for one hour, Monday to Thursday, and a brief time on Fridays was set aside to mark the two pages of a mental arithmetic textbook that constituted the mathematics homework.

The Syllabus used at the school was in transition from *Mathematics K-6* (NSW Department of School Education, 1989) to *Mathematics K-6: Syllabus*

2002 (Board of Studies NSW, 2002). The reporting outcomes and content for the year were based on the 1989 Syllabus, but the overview of outcomes at the beginning of the program were related to the 2002 Syllabus. Therefore, in analysing this data *Mathematics K-6* (NSW Department of School Education, 1989) is primarily used and references made to the three strands of Number, Space and Measurement as detailed in this Syllabus, rather than the six strands specified in *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002). Unless specified otherwise, the term 'Syllabus' when used in this chapter will refer to *Mathematics K-6* (NSW Department of School Education, 1989).

It is necessary to give some details of two factors affecting my life going into 2003, as they both emerge from the data as having some importance in how I coped with teaching this year. Firstly, my daughter developed a serious health condition which made 2003 particularly stressful. Secondly, at the commencement of the school year I was recovering from a broken foot and struggling with mobility, having just had the cast removed. Crutches and a wheel chair were needed to improve my mobility and protect me in crowds of children. I was receiving physiotherapy twice a week to assist in the healing process. My lack of mobility affected my ability to join in morning staff meetings, prevented me from eating in the staffroom and made locating resources very difficult.

Term 1

Workload

Workload, in combination with the difficulties caused by my injury, emerged from the data as the most important issue this term. Prior to school commencing, most of the diary entries dealt with the difficulties presented by my injury and the associated immobility (Diary Y4 T1 2003, 54-62, 65, 71).

My program was due in Week 5 and being unaware of the resources available as well as the difficulties of locating resources, while having very limited mobility, made programming extremely difficult (Diary Y4 T1 2003, 60, 109). At the end of Week 2 I wrote: "I'm finding it hard to find time even for this [writing in my diary]. I am going to the physio twice a week after school and I am programming at every opportunity. At school I am marking, locating resources, trying to work out what I need to know and talking with others. I am up nearly every night to 10.30-11 p.m. I start work straight after dinner, with a laptop on my lap and my foot elevated. When I don't have to go to the physio I...work before dinner too. This is either preparing for the next day or programming and marking" (Diary Y4 T1 2003, 146-148). At the end of Week 4 I organised to have a day off due to the exhaustion of coping with the workload while in extreme pain, using the time to sleep and program (Diary Y4 T1 2003, 199, 210-212). This pace continued until the program was completed in Week 5 (Diary Y4 T1 2003, 214-215), which was a great relief, not only for me but for the more experienced staff on the Stage who had also found it overwhelming (Diary Y4 T1 2003, 239-240).

However, while programming was completed, the need to work late nights and weekends continued. The pace and pressure were relentless and I became increasingly tired and overwhelmed by the job. Snippets of my diary entries over these months best illustrate the lived experience of this time:
Week 8:

- Sunday: "Feeling down - consumed by teaching (which is tiring in itself) and preparing, marking and organising room. Always something to do" (Diary Y4 T1 2003, 300-301).
- Monday: "Getting ready for a casual tomorrow (daughter's tests) was huge...I was at school until 6 p.m. I didn't take work home which was great...but Sunday night I was up until after midnight, after working at school for a couple of hours with Wal" (Diary Y4 T1 2003, 309-310).
- Tuesday: "I did nothing at home, which was great!" (Diary Y4 T1 2003, 315).
- Wednesday: "Gave apologies for board meeting...too much to do, not feeling well and can't cope with the late night out" (Diary Y4 T1 2003, 324).

- Thursday: “I am exhausted at the moment with a cold” (Diary Y4 T1 2003, 334).

Week 9:

- Sunday: “I am unwell and finding it hard to cope. I have homework and handwriting to mark as well as writing up next week’s lesson. I am so tired that I don’t know how to do it. I’m more than tired, I am sick of doing this all the time, I feel like I have no life. When I’m not doing school work I’m feeling guilty. There is so much to do. I don’t feel that I’m teaching well, just basically, no time for thorough planning and preparation. I have done less night-time work this week due to illness, but tonight I have written up my day book for next week” (Diary Y4 T1 2003, 342-344).
- Friday: “I had a lot of trouble with three groups of children having relationship problems. Took 25 minutes of lunchtime to deal with” (Diary Y4 T1 2003, 390).

Week 10:

- Sunday: “I am finding that there is so much to prepare for that only a very cursory preparation for each lesson is possible in all subjects...went in to work today for one and a half hours to organise classroom. Marking handwriting, homework and planning next week tonight” (Diary Y4 T1 2003, 413-419).
- Monday: “Caz (Stage Coordinator) watched me teach HSIE today - it was on the uses of magnets in every day life. I did a good lesson and had excellent feedback - but I spent more time on it that I do usually because there just isn’t the time to be this prepared all the time” (Diary Y4 T1 2003, 424).

Week 11:

- Sunday: “I went to the camp (for the Stage camp next term) site this afternoon...It was fine, but it took 4-5 hours of the day. I still had to come home and prepare for the week. Even having two homework books I am finding it hard to get it marked to get back. Handwriting books, mathematics textbooks, English books, all KLAs have marking and it gets out of hand...I spend a lot of time after school to try and avoid bringing it home, but that doesn't always work” (Diary Y4 T1 2003, 451).

- Saturday: “Holidays!! Well it's over and I feel like I survived. I am exhausted physically and sick of doing school work. It seems to have consumed my life. I need to have some time off, but I hope to start programming in the second week of the holidays to alleviate some pressure when school starts. The pressure isn't just the programming, but working out what to teach when the program isn't complete - this adds stress to the busyness...I'm going to do a lot of sleeping this week - maybe watch a DVD or two. My foot will really appreciate it!” (Diary Y4 T1 2003, 477).

Confidence in my teaching

Confidence in my teaching emerged from the data as an important issue this term. This concerned not only my confidence in mathematics teaching, but in teaching generally and included my content knowledge of both mathematics and other KLAs.

The school year commenced with me feeling unprepared (Diary Y4 T1 2003, 54, 60, 69), nervous (Diary Y4 T1 2003, 62) and out of control (Diary Y4 T1 2003, 71, 107). The afternoon prior to the children starting I recorded: “We were given the afternoon off meetings today to do personal preparation and I felt I hardly knew where to start. I wrote down the day plan for tomorrow (just a skeleton of possible things to do) so that I at least have enough to fill the day. There is so much I don't know and I feel a little like my head is spinning and I can't get a handle on everything, out-of-control I guess. My day plan is my little bit of control” (Diary Y4 T1 2003, 69). At the end of Week 1 I recorded: “There is so much I haven't got a handle on, I wish I had my program up and running...I just don't have everything I need, and don't even know what I need in some ways. Knowing what I need would be a great start” (Diary Y4 T1 2003, 104-107).

The “little bit of control” (Diary Y4 T1 2003, 69) I achieved by writing day plans was replaced with ‘To do’ lists (35 this term) and a day book (Diary Y4 T1 2003, 215). Resources to support the program were organised or located

(Diary Y4 T1 2003, 98, 102, 137, 138, 146, 166, 188, 189, 222) and organisational structures were put in place (Diary Y4 T1 2003, 100, 101, 107, 179, 194, 215, 221). Programming became a priority (Diary Y4 T1 2003, 107, 148, 179) while the day-to-day organisation and face-to-face teaching continued (Diary Y4 T1 2003, 148, 179, 223, 224).

Inexperience, coupled with the huge workload, led to insufficient lesson preparation and feelings of inadequacy. In Week 9 I reflected: “Dannie (the other Year 4 teacher with five years experience) said that a long-time teacher friend advised her that she plans and teaches one good lesson a day, and ‘makes do’ on the rest, as anything else is impossible. I think it might be good advice and when you’re experienced the ‘making do’ might be better. I feel that I don’t have time for even one good lesson. I feel I have fallen short of teaching the content of British Colonisation...I know I would do it better second or third time around and that is the great bonus of experience” (Diary Y4 T1 2003, 342).

My inexperience led me to make mathematics teaching decisions without confidence that my choice of activities would support the desired learning. In the video-taped lesson in Week 10 the content focused on addition using the commonly accepted algorithm involving trading. A textbook page was used as the basis of the activity and students were instructed to use a place value chart and MAB materials to model their solutions. This was done to scaffold their understanding of the algorithm, as it had become evident that many were trying to follow the algorithm without understanding what it represented. The questions were so easy that only simple mental computation strategies were required to get a solution (e.g. 7 + 24 = ?). I reflected: “I was unhappy (cringed) to see students obviously not getting the point about using MAB blocks when they could more readily and easily use mental strategies to solve the problems. This is the result of the required use of the textbook, and my inexperience, the emphasis on the use of a formal algorithm and my insecurities about my students needing to have a thorough knowledge of the algorithm and trading. I wish this could come from necessity (child directed) but I'm not confident enough of how to go about it (Video-notes 3.4.03, 48). I concluded “I find a problem in this ‘discovery’ learning in providing appropriate opportunities to ‘discover’. Some of these students will happily use mental strategies for all of these questions without recognising trading, even if they do it. My insecurities about covering the course adequately (especially for exams and progression) come to the fore” (Video-notes 3.4.03, 49).

While being aware, through my own children’s schooling, that students were taught a different subtraction algorithm than I had been taught at school, the decomposition method of subtraction was unfamiliar. The equal addends method, while being the algorithm I used, was only understood as a procedure, and I ‘borrowed and paid back’ without understanding how it worked. The decomposition method became clear to me in my university mathematics teaching course, but when I commenced teaching Year 4 the need to explain it had never arisen.

The first subtraction lessons of the year occurred in Weeks 9 and 10, with most of the children having more experience in using the decomposition algorithm than I did (Program Y4 T1 2003, 341). Going into those lessons I felt reasonably confident that I could explain the algorithm and answer student questions. However, I struggled with explaining the solutions at the end of the lesson and commented: “I don’t know all of the possibilities that come out of this sort of thing and I get thrown” (Diary Y4 T1 2003, 405-406), “the first 2 [questions] were OK but the third was an extension and I had trouble explaining trading when I quickly addressed it at the end. It’s the first time I’ve had to think of it and I will be better prepared for this problem next time” (Diary Y4 T1 2003, 411).

At the end of term I reflected: “I am not satisfied with my mathematics content knowledge in all areas (I don’t know what I don’t know). I think I know the content and something will come up in a child’s question or in my need to explain something that shows me I need to be more familiar with it e.g. in the use of the subtraction algorithm I came a cropper when I introduced a question with 0 in the tens column and the units column, I was unsure of how to demonstrate trading, I really had to think it through and practise all sorts of possible questions to be comfortable with it" (Diary Y4 T1 2003, 479-480). "Not knowing what I didn't know" referred to my own working knowledge of the mathematics content as well as the depth of knowledge necessary to make organisational and pedagogical decisions about how I would teach it.

While I was familiar with the content, as it was detailed in the syllabus, I did not have the ease of someone who worked with it regularly. Content in all strands, such as topology, tessellations, trading, partitive and quotative division, Platonic solids and triangular numbers, were among a number of topics that were new to me; mathematical concepts and language encountered for the first time in my preservice course. Similarly, some concepts and language had been encountered as a student years before, but had no links to my day-to-day use of mathematics, and had not been utilised for many years. I was concerned that situations might arise where my knowledge of the mathematics was deficient or lacked depth. I had been aware in the previous year, teaching Year 2, that I was developing the needed familiarity with the mathematics content in the course of my teaching. By being well prepared, I could ensure that I was as comfortable as possible with the concepts and language prior to teaching it. However, with the Year 4 content, where I was under-prepared for many lessons, I had little time to ensure that I was conversant with the concepts and language.

I also needed an understanding of the mathematics content from a teacher's, rather than a student's perspective. Brown and Borko (1992) described the "transition from a personal orientation to a discipline to thinking about how to organize and represent the content of the discipline to facilitate student understanding" as one of the most difficult aspects of learning to teach. My experiences had already shown me that teaching mathematics required more than a working knowledge of the content. With thoughtful preparation I was confident that I could reasonably teach any content, but without adequate time for preparation I lacked confidence in the sufficiency of my mathematical content knowledge, generally and as a teacher.

Behaviour management

Behaviour management was an important consideration in commencing the year. Consideration was given to a reward system prior to the commencement of school and set up in the first week of school (Diary Y4 T1 2003, 62, 88, 101). In the first two days of school the class had spent considerable time in groups discussing guidelines for classroom behaviour and establishing a set of class rules. As a whole class we decided that all of the rules, on which they had decided, could be summed up with the word 'respect' (Diary Y4 T1 2003, 124).

Following the first two days of teaching I was generally pleased with the class and felt that a good start to the year had been made in terms of behaviour management (Diary Y4 T1 2003, 105). I noted my need to be "on my toes" with one student, who was "very organising and talkative" (Diary Y4 T1 2003, 95) and to keep an eye on one pair of children I had seated next to each other. I had placed Billie next to Desi, as a result of my supervisor's comments regarding Billie's abilities and character (Diary Y4 T1 2003, 81), to support Desi in settling into a new class. Desi had severe learning difficulties and in previous years had also been quite difficult behaviourally when settling into a new class (Diary Y4 T1 2003, 126). However, the decision resulted in Desi feeling distressed and hurt (Diary Y4 T1 2003, 81, 93, 124) and I had to separate them (Diary Y4 T1 2003, 124). While no direct action was taken to discipline Billie, a general reminder was given to the class about our class rules (Diary Y4 T1 2003, 124).

Mathematics resources

Manipulative materials continue to be an important consideration in my teaching, despite now teaching Year 4. They are used in most lessons in Term 1, often as an intention of programming and sometimes in evaluating the lessons. They were programmed to:

- support problem solving and investigations (Program Y4 T1 2003, 76, 77, 78, 83-85, 102, 108, 110, 114-117, 155, 157, 160-163, 189, 190, 192,

- to model mathematical concepts (Program Y4 T1 2003, 184); and
- to play mathematical games (Program Y4 T1 2003, 217, 316).

Program evaluations included:

- their effectiveness (Program Y4 T1 2003, 90, 204, 300, 304);
- difficulties in locating appropriate resources (Program Y4 T1 2003, 206);
- observations of how students used them and how these indicated their understanding (Program Y4 T1 2003, 170); or
- explanations provided as to why they were not used (Program Y4 T1 2003, 264).

In one lesson I insisted that the students use the MAB materials and the place value charts to complete their textbook work, not to support students in finding the solutions, but to scaffold their understanding of trading in the addition algorithm (Video-notes 3.4.03, 7-13).

Textbook use

The textbook was the focus of most of the mathematics taught this term. It was programmed for most lessons and used for diagnostic testing to assist in establishing those students who would join the gifted and talented program or the support group for mathematics (Program Y4 T1 2003, 179), as well as for revision (Program Y4 T1 2003, 385).

While evaluations of students' textbook completion are mentioned in the program (Program Y4 T1 2003, 168; 268; 396), the textbook is only mentioned, in any detail, in terms of the questions it provided to support students in their early experiences in addition with trading. These were so simple that many students could see no point in completing the algorithm. The textbook supported a procedural approach to trading in 2-digit addition, rather than establishing a need to trade to reach a solution (Video-notes 3.4.03, 9). I commented: "Obviously the textbook introduces the formal algorithm using simple problems for good reason (I know some of my students struggled with trading with the simple questions, they would really have struggled with more difficult questions. However, some of my students would have seen the benefit of a formal algorithm with more difficult questions and had no trouble utilising trading)" (Video-notes 3.4.03, 48).

Active learning

Many of the mathematical activities provided in Term 1 would be categorised as encouraging active learning rather than the passive reception of knowledge (Newmann et al., 1995). In many of the programmed activities (Program Y4 T1 2003, 71, 72, 97, 98, 150, 151, 176, 177, 178, 184, 185, 189-194, 195, 209, 216, 221-222, 238, 247, 252, 273, 282, 306, 311, 314, 360, 378, 400) students were required to practise procedural routines or to "recall information, define, describe, identify, list, reproduce, or state given content knowledge" detailed in the support documents for the NSW model of pedagogy as producing lower-order thinking (NSW Department of Education and Training, 2003a, p. 18). However, many of these were drill and practice activities which were based on the students' conceptual understanding of addition, multiplication, subtraction and division and would be categorised as building foundational knowledge in mathematics (NSW Department of Education and Training, 2003a).

Where non-routine or multi-solution problems and investigations had been provided students were being asked to justify their responses, make judgements and evaluate solutions (Video-notes 3.4.03, 39, 41; Program Y4 T1 2003, 127, 156, 313, 368, 393, 420), recommendations made in the NSW model of pedagogy support documents to encourage higher-order thinking (NSW Department of Education and Training, 2003a).

Problem solving and investigations

Multi-solution problems were programmed four times this term (Program Y4 T1 2003, 278-279, 312-313, 365-368, 418-421), all within the Number strand. The first was programmed for Week 8 and was not completed due to my absence from school and the casual teacher completing the set textbook pages instead (Program Y4 T1 2003, 278-279). The next was programmed for Week 9 and was completed, but not satisfactorily (Program Y4 T1 2003, 313). At the beginning of Week 10 I reflected on my mathematics teaching: “I feel really disappointed with my efforts in mathematics teaching. I am doing OK in Space and Measurement because the text pages are ‘hands-on’ and OK. But I have done little more than text motivated Number units” (Diary Y4 T1 2003, 405), “I am finding that there is so much to prepare for, that only a very cursory preparation for each lesson is possible in all subjects” (Diary Y4 T1 2003, 413).

In Weeks 10 and 11 two lessons included multi-solution tasks and were quite successful in engaging the students in the desired learning outcomes for those lessons (Program Y4 T1 2003, 365; Video-notes 3.4.03, 48; Program Y4 T1 2003, 418-421, 434). The lesson in Week 10 was video-taped. In this lesson the textbook work supported students in a procedural understanding of the addition algorithm with trading, but the questions were so easy that all of the children could obtain an answer without trading. A multi-solution problem was given to provide a challenge that required the students to use trading in finding all possible solutions. Some students found all the possible solutions, though some struggled knowing where to start and I had to stop the lesson and explain “I have been asked this question a few times so you might need to know it too, the answer to this question will not be what is under the line, it will be the whole thing. Mrs Forrester doesn't know the answer; I am looking for some help when we look at possible answers". I then encouraged them to find as many different answers as they could (Video-notes 3.4.03, 21).

Investigations were a regular and successful part of the mathematics program in Term 1, in the Space (Program Y4 T1 2003, 108-110, 191-194, 251, 253), Measurement (Program Y4 T1 2003, 221, 286, 287, 320, 321) and Number (Program Y4 T1 2003, 76-80, 102-105, 155-157, 214, 406-407) strands. Daily speed tests in the multiplication tables were a part of our routine. However, in Week 8 it became obvious that the multiplication facts of 6 were not well known and I decided to replace the programmed tests on the multiplication facts of 7 with an investigation of the facts for 6. I commented: “The students did an investigation of six times tables, as high as they could go. They noticed patterns (e.g. numbers they ended in were 0, 6, 2, 8, 4, 0, 6, 2, 8, 4 etc.). One group wrote up the table for exhibition. I wish we had more time for exploration and reporting” (Program Y4 T1 2003, 298). In my evaluation of the term I commented: “It has become evident that rather than basic tables speed tests alone we need to investigate tables - see patterns and talk about strategies. We started doing this in Week 8. We will continue” (Program Y4 T1 2003, 439).

Discussion

Discussion was regularly programmed to allow students to share the results of their investigations or problem solving (Program Y4 T1 2003, 79-80, 102-105, 108-109, 156, 193, 279-281, 313, 366-368) and to develop students’ understanding of a focus idea (Program Y4 T1 2003, 215, 222, 245, 281, 368, 408, 409, 413, 421). Discussion often gave insight into students’ understandings (Program Y4 T1 2003, 89, 91, 122-124, 127, 232, 393).

However, the quality of discussions did not fit with my ideals of a mathematics discourse community where students would share and justify their solutions and other students would evaluate these solutions and offer alternatives, drawing the important mathematical ideas out of the discussion and offering students the opportunity to reflect on their learning. More often than not, important ideas were not drawn from the discussion but introduced by me: “I introduced the concepts - rather than drawn out of discussion - that “maths makes sense” and “maths is about patterns”” (Program Y4 T1 2003, 93). Discussion was inadequate in drawing out the important ideas (Program Y4 T1 2003, 394) often due to lack of time, but sometimes due to my lack of clarity on the content (Diary Y4 T1 2003, 411).

In the video-taped lesson in Week 10 expectations for discussion were not focused on guidelines for listening to each other but on evaluating other students' solutions within the context of "maths making sense" and incorrect solutions being an opportunity to learn. No fuss was made if solutions were right or wrong, students were writing up alternatives or changing those they thought were incorrect (Video-notes 3.4.03, 39). I reflected "I was happy that I allowed a reasonable amount of time to share solutions, although some of this was very teacher directed. I find this part challenging as these students (like Year 2 in 2002) struggle listening to other students. I need to keep working on this, as I feel like this sharing time loses some children's interest, usually the ones who would benefit most" (Video-notes 3.4.03, 50).

Students' upsets

Four incidents concerning student upsets were recorded this term. The first resulted from my seating two students (Billie and Desi) together, based on information I had been given by my supervisor who was also their previous teacher (Diary Y4 T1 2003, 81). The decision obviously caused distress to both students (Diary Y4 T1 2003, 93), with the result that Billie made it very clear that he did not like sitting with Desi, hurting Desi's feeling and requiring that I separate them (Diary Y4 T1 2003, 124).

In the parent/teacher interviews in Week 3 several parents raised issues regarding their children experiencing relationship problems with other children (Diary Y4 T1 2003, 157). Assurances were given that inappropriate behaviour would not be tolerated and encouragement given to bring incidents to my attention if and when they occurred.

In Week 9 pen licences were issued (where students whose handwriting was considered neat enough were given permission to use a pen instead of a lead pencil in handwriting lessons). This was the normal practice at this school in Year 4, and several students who did not receive a licence were upset (Diary Y4 T1 2003, 351). The following day I had a complaint passed on from my supervisor that Billie was unhappy and bored (Diary Y4 T1 2003, 368). In following that up with him, he could not identify where the problem lay, in terms of boredom, as he was happy with the individual units of work he was doing in his home class as well as his accelerated English class. He shared with me that he was unhappy in his friendship group (Diary Y4 T1 2003, 385) and this was followed up (Diary Y4 T1 2003, 390).

Providing a safe environment for all the students in the class was a priority and our classroom rules were displayed on the wall and regularly highlighted, as they were following the problems between Billie and Desi (Diary Y4 T1 2003, 124). Any complaints from students were treated seriously with every effort made to be fair and supportive.

Teacher/student relationships

Student/teacher relationships were developing this term and the child I was most concerned to support in those early stages, due to his severe learning difficulties and associated social problems, appeared to be settling in well and felt confident enough with me to bring his concerns to my attention (Diary Y4 T1 2003, 93, 126). In the video-taped lesson in Week 10 my relationship with the students in the course of the lesson seemed positive and supportive (Video-notes 3.4.03, 17, 21, 29, 41) and many students were confident enough to actively participate in sharing time (Video-notes 3.4.03, 44).

Time constraints

The mathematics program was difficult to cover adequately in the four hours a week it was allotted, with several activities either not completed or inadequately covered (Program Y4 T1 2003, 110, 194, 246, 287, 304, 307, 313, 321, 361, 367, 368, 369, 376, 401, 413). It is not clear whether this was due to my inexperience or whether the program had too much in it. My program was based on the one I had been given prior to the commencement of term and so the amount of work it sought to cover was similar to that of the previous Year 4 class (Diary Y4 T1 2003, 60). At the end of the term I commented: “Being the more able class, most children are picking a lot of things up quickly. Despite this we are still pressed for time to cover the program” (Program Y4 T1 2003, 440).

One of the tasks that took up considerable class time was marking the textbooks. This was due to the workload of teaching generally, which has already been discussed. In Week 10 I commented: “I have found marking to be a huge chore this year. For survival I must get the children to be part of this, it takes me forty minutes to one hour, on average, to mark one page. I just don't have time” (Video-notes 3.4.03, 45).

Themes

In the first two weeks of term students completed several addition and multiplication fact investigations and the ideas that “maths makes sense” and “maths is about patterns” were introduced into the discussions (Program Y4 T1 2003, 93). These became regular themes in our mathematics lessons (Program Y4 T1 2003, 125, 409) along with "maths isn't about tricks" and "making errors in maths is not a bad thing, we can learn from them" and "I'm interested in how you are doing it rather than if you get the right answer" (Video-notes 3.4.03, 46).

Routine

Routines in the classroom were quickly established, both generally and in mathematics lessons. In mathematics, daily speed tests were quickly established and students were efficient, even at this stage of the year, in preparing, completing, marking and collecting them (Video-notes 3.4.03, 5). Early in the term I had established position statements as a routine in determining the student at each cluster of desks responsible for collecting textbooks, grid books and speed test booklets. This provided students with a need to become familiar with position language (Video-notes 3.4.03, 5, 47).

Support

In commencing teaching this term with limited mobility, I received considerable support from my family in cleaning and setting up my room (Diary Y4 T1 2003, 62, 301, 310) and transporting school materials (Diary Y4 T1 2003, 148). The school executive excused my attendance from some compulsory staff activities (Diary Y4 T1 2003, 71) and provided school duties that took into account my limited mobility (Diary Y4 T1 2003, 83). Individual staff members provided emotional support (Diary Y4 T1 2003, 67) and practical assistance (Diary Y4 T1 2003, 71).

While staff members were approachable and supportive (Diary Y4 T1 2003, 67, 107), my lack of mobility and the steep terrain at the school necessitated me eating lunch and morning tea in my room. As a consequence, I felt increasingly isolated and at the beginning of Week 8 I commented: “People have been nice, but I feel a little hurt that I spend my recess and lunch in the classroom, because I can't get up to the top [of the hill] to the staffroom and no one has thought to say to Stage staff at least, "let's eat with Tricia"...I feel Caz (Stage Coordinator), at least, should have given it some thought. Now I feel like a whinger. I'm not going to say anything, but it isn't great staff support, from above, and not very thoughtful from my peers” (Diary Y4 T1 2003, 303).

Lesson 3rd April, 2003

Table 24 Year 4 3.4.03 - Coding sheet Dimension 1

Year 4 3.4.03 - Coding sheet Dimension 1 – Intellectual Quality					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
1.Deep knowledge	Mostly focused on addition with trading though speed test was 3 x table.	4	Content	The big idea was addition with trading which fitted within the Key Ideas of the Syllabus for Stage 2 Addition: working toward the “use of a formal written algorithm for addition” (p. 49) and the Knowledge and Skills of “adding...two or more numbers, with...trading” (p. 49). Focus was sustained except in the speed test.	4
			Explicit focus	The focus was clearly expressed before the textbook activity several times and briefly in the discussion.	4
2.Deep understanding	Most students demonstrated conceptual understanding of addition with trading in the challenge – some deeper than others.	3	Teaching for conceptual understanding	The textbook activity was procedural (and set up that way in the textbook with a grid similar to the one the children drew in their books at the top of the page with longs and shorts drawn and an explanation with the algorithm next to it) – the questions themselves did not require any trading as students could work them out very easily in other ways. The work in	4
4.Higher-order thinking	The challenge required higher-order thinking. It filled a substantial portion of the lesson.	4			

Year 4 3.4.03 - Coding sheet Dimension 1 – Intellectual Quality					
				their grid books with MAB blocks was included to scaffold a conceptual understanding of the algorithm not addition. The challenge required a conceptual understanding of addition to get the answer 42, a conceptual understanding of trading to get 52, and to be able to explain why there were no solutions to get an answer of 62.	
3.Problematic knowledge	The lesson presented mathematics as making sense, but not always a one answer/one approach subject.	4	Problem solving	Problem solving was meaningful and challenging though not real-life. It enabled students to use their addition and trading experiences to form solutions. The procedural textbook work took significant time but was structured to scaffold understanding. The speed test was supported by previous investigations of the number facts. These took a substantial portion of lesson time.	4
5.Metalanguage	The terms 'score', 'dozen', 'longs', 'tens', 'units' 'trading', 'adding' were used. 'Score' and 'dozen' were explained. 'Trading' was used in response to a child using the term 'carrying' when showing how to trade but no further comment was made. Other words were used without comment, as all students were familiar with them.	3	Discussion	Discussion involved most of the children. Expectations of behaviour at this time were clear and evidenced in their behaviour. Most students were attentive. I corrected student errors, but so did the students. No further investigation came out of this discussion. This was all done in a positive atmosphere.	4
6.Substantive communication	Discussion was substantive with solutions written on the board by students, corrected (without fuss) and discussed by me and the students. The students also wrote in their grid books, though these were not reflective but included attempts at solutions.	4	Written work	Textbook, grid books and whiteboard were all used for writing. The textbook work was recording solutions to practise sets. The grid book showed students' solution attempts and in some cases working out. The whiteboard work showed students' solutions, included errors and the correction of those errors by students. No opportunity for recording thinking was encouraged.	3
			Student reflection	The nature of this discussion provided opportunities for reflective thinking, and this was evident in students' correcting their own and others' efforts. The questions "Does that work?" and "Does that make sense?" were reiterated throughout the lesson and students were looking at their solutions with this in mind. More student involvement in the discussion	4

Year 4 3.4.03 - Coding sheet Dimension 1 – Intellectual Quality					
				would have been worthwhile.	

Table 25 Year 4 3.4.03 - Coding sheet Dimension 2

Year 4 3.4.03 - Coding sheet Dimension 2 –Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	The requirements of the work were repeatedly and clearly explained. One of the criteria was that their solutions had to make sense and students were checking out their solutions in line with this. They were also required to find as many solutions as they could. Most students were involved in this, some looking to me and each other to see how they were going in this.	4			
8.Engagement	This was variable but there were a few off-task behaviours. Most students were working and trying hard most of the time.	4	Motivation	Motivation was variable as evidenced in engagement. The lesson had variety and its pace suited many students. They had adequate time to work out solutions and they were not bored before the end of the session. Some students tired of the challenge, usually because they were having difficulty working out a solution or seeing more possibilities. Some students were motivated the entire lesson, keen to find another solution and share that with friends and me. The structure of the discussion seemed to motivate a lot of students to participate and most students were attentive, even if they did not contribute a solution or correct one it was evident they were checking them.	4
			Mathematical resources	MAB materials were the only resources available in the lesson. They were suitable for the activity. They were used to demonstrate/explain/model procedures and solutions. The students were expected to use them.	2
9.High expectations	All students expected to take part in the challenging work though some only managed to	3	High expectations of behaviour	Guidelines for classroom behaviour are written on the wall. Acceptable behaviour in	5

Year 4 3.4.03 - Coding sheet Dimension 2 –Quality learning environment					
	find solutions without trading. All students were encouraged to take risks, though the competitive aspect of finding as many as possible was motivating for some students it may have made risk taking less appealing for others who felt less adequate at finding more solutions.			mathematics discussions had been spoken about regularly in previous lessons and was alluded to and reinforced throughout this lesson. The one or two minor misbehaviours were dealt with appropriately and consistently.	
			Risk taking	The focus of the lesson was sometimes on 'right' and 'wrong', mostly on learning but not often on teamwork except in the discussion. Most students actively sought help when required and volunteered answers. Students were recognised for taking risks. The rules for engaging in the lesson were evident in students' behaviours.	4
10.Social support	Social support was clearly positive and attempts to support those struggling with the textbook requirements and the challenge were evident.	4	Social organisation	The lesson was structured for individual work though several students worked together in pairs.	1
			Teacher's relationships	I started off the lesson quite reserved but relaxed throughout the lesson. I evidenced positive supportive behaviours to most students and made clear attempts to support reluctant students.	4
11.Students' self-regulation	Many students demonstrated autonomy and initiative and regulated their own behaviour. Some interruptions for behaviour management did occur.	3	Student autonomy	Some students were easily frustrated by the challenge and needed lots of support to persist. Many showed autonomy and initiative in their mathematical behaviour most of the time (a few all of the time).	3
12.Student direction	The multi-solution problem was the only aspect of choice in the lesson.	2	Problem solving & resources	Resources were teacher-directed. The challenge was a multi-solution problem. Many students were able to get a solution, most got several solutions and some got many solutions.	2

Table 26 Year 4 3.4.03 - Coding sheet Dimension 3

Year 4 3.4.03 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	Students' background knowledge of addition strategies and MAB materials was mentioned. No out-of-	2	Building on prior knowledge	The lesson builds on previous experiences in class with trading, and was planned to deal with difficulties evident in these	3

Year 4 3.4.03 - Coding sheet Dimension 3 – Significance					
	school knowledge is referred to.			lessons. It included prior knowledge of vertical addition algorithms and an understanding of the multiplication facts of 3.	
14.Cultural knowledge	N/A	1			
15.Knowledge integration	No meaningful integration.	1	Teaching for the transfer of knowledge.	A few meaningful connections were made between the thinking used to work out answers and the answers. These could have been more clearly made to support those students who had difficulty with the challenge.	3
16.Inclusivity	No students were excluded (though several students did not contribute much). The process of getting solutions to the challenge was vocally dominated by males, although females were also getting solutions.	3			
17.Connectedness	I made the connection between the content of the lesson to the need to add up big numbers. This was not trivial or superficial, more hypothetical or abstract, but it was my connection and there was no evidence of the students recognising this or any other connections outside the classroom.	2			
18.Narrative	None.	1			

Reflection on the lesson of 3rd April 2003

This lesson is the best lesson video-taped in the two years, in terms of the elements of the Intellectual Quality dimension of the NSW model of pedagogy (NSW Department of Education and Training, 2003e). There was a balance of activities including: basic facts practice; non-routine problem solving encouraging conceptual understanding; and routine problem solving, including the use of the commonly accepted algorithm for addition with trading, which encouraged a largely procedural understanding, but also supported conceptual understanding of the algorithm. Although some students automatically worked together to find solutions, most worked individually. The utilisation of group work for finding solutions to the non-routine problem would have been more beneficial in supporting those students struggling to find more complex solutions that required trading.

Focus for improvement

In terms of focusing my efforts to improve my teaching, I approached this first term of teaching full-time in the same way as I had the previous year. I was determined to try to implement elements of best practice in mathematics education, while evaluating the needs of the class and shortcomings in my teaching to determine the focus for improvement in Term 2. The workload, coupled with my inexperience, affected the time I had to plan and prepare for individual lessons, and while I was not satisfied with any element of my efforts to be a more effective teacher of mathematics, it became obvious that the added pressure of trying to implement specific practices would be unmanageable. At the end of the term I reflected: "It has become very obvious that my main focus this year in mathematics will have to be coming to terms with the Year 4 content and trying to identify associated student thinking. I will try to incorporate non-routine questions into my lessons and provide group learning activities and class discussion, but they cannot be my main focus. I can see I will not have enough time to thoroughly prepare for these things like I did in Year 2 last year, when I am not satisfied with my mathematics content knowledge in all areas (I don't know what I don't know)" (Diary Y4 T1 2003, 480).

Term 2

Workload

Workload continued to be a major issue this term. The day before school started I commented: "I have had a break but I am still not ready to face the term. I did a couple of days sorting out programming but didn't achieve a lot. I've worked tonight on planning the week without a really good handle on the term, but some things just continue...This term is going to be huge with programming, reporting and camp" (Diary Y4 T2 2003, 19-20).

In Weeks 1 and 2 three lunch times were taken up with organising a craft activity for Mother's Day and a lunchtime meeting to organise the camp (Diary Y4 T2 2003, 53, 57). Three days in Week 2 were spent away on the Stage 2 camp (Diary Y4 T2 2003, 72-79). I returned from camp exhausted and in considerable pain from being constantly on my injured foot (Diary Y4 T2 2003, 84). In Week 3 parent/teacher interviews were conducted after school on Monday until 9 p.m. and Thursday until 6 p.m. I commented: "I feel like I do nothing but school work" (Diary Y4 T2 2003, 116) and later in the week: "I am exhausted. I am working at least 10 hours on the weekend as well as late nights 4 or 5 nights a week. I feel like I am being consumed and never get a break" (Diary Y4 T2 2003, 138).

Programs were due in Week 5 and reports in Week 6 (Diary Y4 T2 2003, 138-140) and the pressure of both led to my comments:

- Week 4: "I have felt 'on the edge' this week. I am working to 10.30-11 p.m. or later every day and it is getting to me. I have so much on my mind that I don't feel I work very well or achieve as much as I would like" (Diary Y4 T2 2003, 199).
- At the end of Week 5 "I have been doing school work for reporting every night until at least 10.30 p.m. and Saturday night until 12.30 a.m. I feel exhausted and rung out. This week will be spent keeping children occupied profitably while filling in the gaps in assessing. We were told this week that the reports due date has been moved from Friday 6.6 to Tuesday 10.6 I can't cope with the thought of doing this for another weekend I must have it done by Friday. My weekend has been reporting and sleeping, what a life" (Diary Y4 T2 2003, 215).
- At the beginning of Week 7: "I was sick - stress on Friday. I slept until 1 p.m. and started work on reports at about 2 p.m. Saturday 10.30a.m.-11.30 p.m. to finish them. I have worked every night last week as well until at least 10.30 p.m. I have been feeling 'punchy'. Handwritten reports are crazy and add about one and a half days (12-15 hours) of extra work and I think it is disgraceful. Why is this not available on disk?" (Diary Y4 T2 2003, 247).

Completing the reports late on the Saturday night, I then had two days off, the Monday being a public holiday. Returning to school I commented: "I am very distressed and I got knots in my stomach at the thought of going back to school today. I don't know how I am going to make it to holidays. I still have to plan for this week and mark reports on communication as well as two lots of homework. I don't feel capable of more than the planning...I am so overwhelmed by the survival, I cannot concentrate on improving mathematics teaching" (Diary Y4 T2 2003, 249-251).

At the end of term my relief at its completion was tempered by the necessity of attending a compulsory school conference, ironically focusing on coping with stress, on the Monday and Tuesday of the following week. I wrote: "I am completely exhausted and in some ways demoralised. I am so tired of school work which seems to take up every waking moment, and I am not exaggerating when I say I feel physical revulsion at the thought of doing any school work or preparation. I am concerned about coming back to school unprepared for next term but can't do anything about it - I am so tired" (Diary Y4 T2 2003, 334).

Students' upsets

There were several incidents recorded in my diary this term referring to the upsets of individual children and problems within social groups. Issues with one of these students, Billie, emerged as very important from the data this term. The unfolding situation became a major source of distress. It had begun in the first week of school in Term 1 with his unkind behaviour to Desi (Diary Y4 T1 2003, 93, 124), followed by him being upset in Week 9 saying he was bored and subsequently (Diary Y4 T1 2003, 368), upset by not getting his pen licence and having problems in his social group (Diary Y4 T1 2003, 385). His social group continued to have problems throughout Terms 1 and 2 (Diary Y4 T1 2003, 390; Diary Y4 T2 2003, 105, 197). The diary entries document the unfolding events, including those to do with his social group:

- Week 1, Wednesday (first day of school): “Billie came into class crying and saying he is sick. I questioned him about any problems and he told me he was going to [the] doctors and he’s been sick all holidays. He went home” (Diary Y4 T2 2003, 32).
- Week 1, Thursday: “Billie not in” (Diary Y4 T2 2003, 42).
- Week 2, Monday: “Billie came in upset and was brought to class by Dallas (Deputy Principal) crying - Dallas saying Billie bored” (Diary Y4 T2 2003, 55).
- Week 2, Tuesday: “Billie crying again - late to class - he was in Robin’s (Stage 1 Coordinator) class upset when dropped off to school” (Diary Y4 T2 2003, 61-62).
- Week 2, Wednesday, Thursday and Friday we were away on the Stage 2 camp (Diary Y4 T2 2003, 72-79).
- Week 2, Saturday: “Camp went well though Billie went home upset (from camp), being very upset when he came to school (before camp and being persuaded to go). I had a good talk to him for about one hour before Mum and Dad picked him up at 10.30p.m. Meredith (school counsellor) could not convince him to stay. I hope this is a start to a better relationship” (Diary Y4 T2 2003, 81-82).
- Week 3, Monday: “Billie did [a] presentation for public speaking competitions first - he was excited to do it - his artwork was very creative” (Diary Y4 T2 2003, 89). He subsequently received one of the two merit awards given weekly for his artwork (Diary Y4 T2 2003, 118).
- Week 3, Tuesday following parent/teacher interviews: “There were a few mums of children concerned about relationship problems in one peer group - they have reason to be - I assured them I will seek to ensure students feel safe and asked them to bring issues to me as they arise so they can be dealt with quickly” (Diary Y4 T2 2003, 105).
- Week 3, Wednesday: “Sidney (new Stage Coordinator)...indicated Billie was scared of me” (Diary Y4 T2 2003, 114).
- Week 5, Sunday: “Social problem in a children’s group has been a big problem and a lot of parental feedback about children’s pain in relation to this group, Dallas has said she will deal with this and I am glad because

> another mum came to see me today. Billie seems much happier and I am concerned that his desire to change classes and trying to say his unhappiness is due to boredom was to leave the group and save face (Diary Y4 T2 2003, 197).

I became increasingly upset and frustrated by the situation with Billie, having the problems brought to my attention (Diary Y4 T1 2003, 368; Diary Y4 T2 2003, 55), talking to him and feeling that matters were resolved or improving (Diary Y4 T1 2003, 385; Diary Y4 T2 2003, 81-82) to have them reappear.

After parent/teacher interviews in Week 3 Sidney also spoke to me about a child who was in my English class and was feeling unsure of me (Diary Y4 T2 2003, 114). I rang his mother to clarify the problem and was told that he was very sensitive and had become worried that if he did not complete his work he would be kept in at recess time (I had told a group of children, playing around in reading groups, that they would have to complete their work at recess if they continued to waste time). Dominique had become fearful that if he did not complete his work that he would be also be kept back. He always worked well and was very conscientious, but only having him for English I did not know him well enough to realise this would worry him. Subsequent to my conversation with his mother, I spoke to Dominique and reassured him and recorded later in the week that he “seemed fine” (Diary Y4 T2 2003,134). This was no longer a problem and Dominique appeared comfortable and secure for the remainder of the year.

This incident, coupled with the continuing problems with Billie undermined my confidence and I recorded in Week 3: “I feel devastated and under scrutiny. I hate this - I feel so ‘public’ as a teacher” (Diary Y4 T2 2003, 114). “[This is] really distressing and I feel concerned for them [Billie and Dominique] and very vulnerable” (Diary Y4 T2 2003, 130). I felt criticised and unsupported by my supervisor (Diary Y4 T2 2003, 132, 193) who told me there were problems but offered no support or suggestions of a way forward. I provided extension projects for Billie, to ensure he was not bored.

Assessment

Being a reporting term assessment was a very important issue to emerge from the data. The assessing and reporting process was very time consuming, many references already referred to when looking at the impact of the workload this term. It also affected my teaching in the first five weeks of the term:

- Week 3 Tuesday: “I am teaching mathematics to reporting outcomes for the next two weeks then assessing formally” (Diary Y4 T2 2003, 99).
- Week 3 Wednesday: “The students seemed to do well on relating multiplication and division. I used explanation and demonstration using concrete materials I don’t have time to let them ‘discover’ it as well as complete pages and I know I have to do it for assessment which is a written test” (Diary Y4 T2 2003, 112).
- Week 3 Saturday: “I have been focusing this week on setting up assessment for reports due in Week 6. Program is due in Week 5” (Diary Y4 T2 2003, 140).
- Week 4 Saturday: “Term 2 is a great frustration. I have had to teach to assessment regardless of needs and some areas in mathematics have just been touched on. I feel overwhelmed by this [reporting]. A page for each major subject - 13 outcomes for English and 20 outcomes for mathematics. Half a page for other KLAs - 3-4 outcomes each. A comment on each subject as well as 15 social skills/character outcomes and a comment” (Diary Y4 T2 2003, 189).
- Week 5 Saturday: “This week will be spent keeping children occupied profitably while filling in the gaps in assessing” (Diary Y4 T2 2003, 215).
- End of term evaluation: “It was very disjointed in terms of following the program. This had a fair bit to do with assessment and revision. Some things needed completing earlier than planned, other things got put back to do assessing. The exams were basically the same as last year with minor adjustments - hence the need to change the program. The exams were very formal, but the children coped well - they are used to it” (Program Y4 T2 2003, 319-320).

Confidence in my teaching

Confidence in my own teaching was quite badly shaken this term, in my struggles to cope with the workload of simultaneously completing programming and reporting (Diary Y4 T2 2003, 189, 199, 215, 247), while coping with day-to-day teaching (Diary Y4 T2 2003, 53, 144), preparation for and involvement in the Stage 2 camp (Diary Y4 T2 2003, 48, 73-79, 82-84), parent/teacher interviews (Diary Y4 T2 2003, 97, 121, 169, 186, 289) and the issues they raised (Diary Y4 T2 2003, 103-105, 114, 132-134, 213), as well as the unfolding difficulties with one of my students (Diary Y4 T2 2003, 32, 55, 82). Associated with these were feelings of vulnerability, fragility and exhaustion (Diary Y4 T2 2003, 130, 138, 193, 199, 268, 334).

My inexperience made quite simple jobs more complicated and time consuming than necessary, because I had never done them before (Diary Y4 T2 2003, 84). Facing a question about the Gifted and Talented (G & T) program, at parent/teacher interviews, from the father of a child who was accelerated from Year 3 into my Year 4 mathematics class caught me unawares. His question involved the acceptable level of performance of children in an accelerated class, to justify their continued acceleration. The school's G & T program had not issued criteria for continued inclusion in the program and I was unaware of any guidelines for this from either my preservice education or professional development courses. This saw me feeling 'unstuck' (Diary Y4 T2 2003, 103) and 'on the back foot' (Diary Y4 T2 2003, 213) and made me realise the insufficiency of my knowledge in so many areas (Diary Y4 T2 2003, 213).

In terms of my efforts at improving my mathematics teaching by implementing elements of best teaching practice, at the beginning of Week 7 I recorded: "I am so overwhelmed by the survival, I cannot concentrate on improving mathematics teaching - I feel the only worthwhile thing I have done there is helped them learn their 8 and 7 times tables through drill speed tests against themselves" (Diary Y4 T2 2003, 251).

My inexperience coupled with my knowledge of best practice in mathematics education led to feelings of inadequacy, having an idea of how I wanted to teach but struggling to know how to go about it. In Week 9 I reflected: "I am not happy with how I did subtraction with trading. A lot of children had trouble with trading - some children trade if they need to or not...I gave children an opportunity to work out an algorithm at first but ended demonstrating and giving lots of practice. Lots of children do the subtraction in their heads and can't work out how to use trading marks. I don't know how I'd do it differently" (Diary Y4 T2 2003, 319-324).

Medical/Family concerns

The immobility caused by my injury was no longer a problem this term, although it continued to need physiotherapy and still caused pain (Diary Y4 T2 2003, 29, 84, 206). My daughter's health problems continued to be monitored and investigated with continuing fears about her long term prognosis (Diary Y4 T2 2003, 4-5. 23-25). I had one day off school this term due to an accumulation of stress (Diary Y4 T2 2003, 240, 247), and tiredness from my workload and stress related reactions were evident (Diary Y4 T2 2003, 20, 101, 114, 130, 138, 193, 199, 211, 215, 247-249, 251, 268, 292, 334).

Problem solving and investigations

The only multi-solution problems posed were in Measurement lessons and included the challenges to make a template of a square metre from newspaper for measuring activities (Program Y4 T2 2003, 140) and to calibrate a litre container (Program Y4 T2 2003, 215). Investigations continued across all strands including Space (Program Y4 T2 2003, 106, 168-170, 209), Measurement (Program Y4 T2 2003, 214, 245, 275, 301) and Number (Program Y4 T2 2003, 131) with investigations into multiplication tables continuing (Program Y4 T2 2003, 77, 124, 232, 262). In Week 3 I commented: "Students are getting good at identifying patterns in tables and sharing strategies" (Program Y4 T2 2003,149).

Mathematics resources

The importance of manipulative materials continues to emerge from the data this term. They were programmed to:

- support problem solving and investigations (Program Y4 T2 2003, 106, 133-134, 140-141, 163, 168-170, 203-204, 209-210, 214-215, 245-246, 267, 272-273, 295, 300-301);
- to model mathematical concepts (Program Y4 T2 2003, 83, 99, 130, 238); and
- to play mathematical games (Program Y4 T2 2003, 237).

Program evaluations included:

- their effectiveness (Program Y4 T2 2003, 91, 153, 155, 181, 193);
- difficulties in locating appropriate resources (Program Y4 T2 2003, 117, 183); and
- observations of how students used them and how this indicated their understanding (Program Y4 T2 2003, 285).

Active learning

As in Term 1 many of the mathematical activities provided in this term would be categorised as encouraging active learning (Newmann et al., 1995) and similarly many of the programmed activities (Program Y4 T2 2003, 77-78, 83-84, 95, 99, 101, 123-124, 130-131, 134, 159, 200, 232-233, 238-239, 262-263, 267, 273, 291, 295, 300) required students to engage in activities producing lower-order thinking (NSW Department of Education and Training, 2003a), though many of these would be classified as building foundational knowledge (NSW Department of Education and Training, 2003a).

While investigations continued this term there was no focus on providing a problem solving approach to explore mathematical concepts, the only multi-solution problems being challenges to make appropriate resources to be used in measurement activities (Program Y4 T2 2003, 140, 215).

Behaviour management

Behaviour management was not a major issue this term. One reference refers to a pre-camp assembly to inform the children of what they could expect on camp and expectations of their behaviour (Diary Y4 T2 2003, 66). Two other references concern a student who had been constantly in trouble throughout Term 1: “Paris has been so much better this term and I think my change of approach has helped this a lot. Table points have been much better - no lunch detentions - happier all around” (Diary Y4 T2 2003, 195); the other reference being when he received a weekly encouragement reward for improved behaviour (Diary Y4 T2 2003, 118).

Discussion

While discussion is only mentioned a few times in the program this term (Program Y4 T2 2003, 100, 128, 272, 314) it was a part of nearly every lesson. The only reference to students’ involvement in discussions is made in Week 3: “Students are getting good at identifying patterns in tables and sharing strategies” (Program Y4 T2 2003, 149).

Term 3

Workload

Term 3 was quieter than Terms 1 and 2, but workload coupled with a decrease of my motivation was important this term. The exhaustion from the previous term had meant I spent no time in preparing for Term 3 in the holidays until the day before school started, when I made some programming notes to ensure I had my first week under control (Diary Y4 T3 2003, 5). At the end of Week 2 the school was unexpectedly closed for a day, but instead of the necessary programming, I was sick with a headache (Diary Y4 T3 2003, 46). Programming seemed more difficult this term as I struggled with motivation:

- Week 3, Saturday: “I have found it so hard to get into programming this term. I still feel drained and get feelings of revulsion at school work -

which seems to take so much time. I finally stopped fiddling and got stuck into it and achieved a bit, but I'm so tired of it. At the moment deadlines seem to be my only motivation, plus survival. I plan what I need while trying to keep on top of marking and programming HSIE (for the others on my Stage)" (Diary Y4 T3 2003, 84-86).

- Week 4, Saturday: "I still have work to do on my program and feel really pushed to get it done, but have no energy or enthusiasm. I seem to fiddle. I have done HSIE for the Stage while S & T, Divinity and PDHPE is being done by different teachers on the Stage for us all. I have only been responsible for English, Mathematics, Creative and Practical Arts and Computing, yet it seems so hard. The HSIE unit is difficult - resources for local aboriginal societies require research to places I haven't got time for and we really should have an aboriginal cultural experience with a speaker or an excursion. I will recommend it for next year. I have used the textbook and last year's program to program for mathematics and finally got a copy of the Teacher's Resource Book for the text which has some helpful things in it. I have found it too hard to incorporate open-ended questions and problem solving approaches with the [school] emphasis on textbook coverage. I feel overwhelmed by the amount of work required, not only in programming, so the text is a life saver. I feel I am coming to terms with the content of the Year 4 mathematics course - this is true of all subjects HSIE, S & T especially - grammar too!" (Diary Y4 T3 2003, 109-115).
- Week 5, Tuesday: Being a member of the board of another school I had to give my apologies for a scheduled board meeting due to programming (Diary Y4 T3 2003, 138).
- Week 5, Thursday: I handed in my program (Diary Y4 T3 2003, 147).
- Week 5, Saturday: "My program got a good response from Sidney (Stage Coordinator). Thankfully it is over now for another five weeks" (Diary Y4 T3 2003, 152).

The schedule continued to be full with extra activities such as parent/teacher interviews (Diary Y4 T3 2003, 62, 78), the public speaking competition (Diary Y4 T3 2003, 10, 210, 275-276) and an inservice course (Diary Y4 T3 2003, 241), all requiring extra hours at school. Other activities also required considerable planning and preparation including the addition of visiting Japanese exchange students in our class activities (Diary Y4 T3 2003, 81, 106), Grandparents' day (Diary Y4 T3 2003, 273, 279), children's HSIE PowerPoint (Microsoft, 2003) presentations to parents (Diary Y4 T3 2003, 213, 222, 232, 253, 270, 282, 284-287) and the design and construction of a two-page contribution to the School yearly magazine representing our class (Diary Y4 T3 2003, 160, 182-183).

The workload affected the amount of time I could spend on lesson preparation, reflecting on my video-taped lesson in Week 10 I commented: "I simply do not have more time to plan my lessons. I am very time poor, exhausted frankly" (Video-notes 25.9.03, 22). Bringing this up with one of my PhD supervisors I was reassured that experience enables the streamlining of much of the workload, leading to my reflection: "it seems heartless...that new teachers have to work under so much pressure, without more time for preparation and marking" (Diary Y4 T3 2003, 346).

After the term had finished I recorded: "I feel relieved - I stayed up to 11p.m. last night marking and still have a lot of marking to do. I will try to have a week off next week. I feel daunted about next term - we have programming again and reporting - I actually feel scared about the effect of this on me after Term 2. I can't wait till the end of the year" (Diary Y4 T3 2003, 338-340).

Students' upsets

The situation with Billie seemed to have improved in the first weeks of this term (Diary Y4 T3 2003, 150), he was coming to school without tears and upsets. My feelings and actions during this time are not recorded in my diary, due mostly to my embarrassment and the sense of failure I felt in being unable to build a positive relationship with him. I was unsure of how I should deal with him, I felt I was 'walking on egg shells', nervous of how he might react and not happy with his behaviour towards me, although I could not put my finger on anything explicitly rude or disrespectful. I felt I could not talk to my supervisors about it as I had received no support previously and I could not successfully analyse his behaviour. The closest I could come in describing it was the notion of ‘passive aggressive’ behaviour (a concept I had encountered in parenting books), and I searched unsuccessfully for behaviour management books that might help me in a way forward.

At the end of Term 2 I had approached the STLD (Support Teacher Learning Difficulties), Alex, to ask for her support in running a paired reading program to temporarily replace silent reading time, for 15 minutes each afternoon, and encourage children, particularly those still struggling with reading fluency. This commenced in Week 5 of Term 3.

At this time of the year, students were changing seats fortnightly, based on drawing names out of a hat. We did this on Friday afternoons after distributing fortnightly awards for table points. The students had voted on several ways to determine seating and the majority chose this. Several students with particular learning needs stayed in their allotted seats, but everyone had the opportunity to sit with someone new each fortnight. From my perspective it worked quite well, as any poor combinations of students, in terms of behaviour, were resolved in two weeks. A reminder of our guidelines for appropriate behaviour were always briefly stated before this process, to avoid hurt feelings from inappropriate comments or behaviour if a child did not get to sit with a friend. At the end of Week 5, when Billie was seated with Martie, I was aware that he gave him a clear message that he was not happy to be seated next to him. It was obvious from his body language that Martie was hurt, but he followed Billie around while Billie decided where they would sit. I spoke to Martie to confirm what had happened, pulled Billie aside to ask for his perspective then told him that his behaviour was inappropriate, that he had hurt Martie’s feelings and would have a 10 minute lunchtime detention on Monday (the expected consequences of this type of behaviour). It was within this context that the next major incident concerning Billie arose:

- Week 5, Saturday: “I thought things were going well with Billie - he’s not warm but laughs at my jokes and usually takes part in activities. I saw some problems with paired reading and him (he moaned when told we would be doing it for a while) and treating Alex (STLD) the same way [he treats me]. I was a little disturbed that he sits up straight and shoots his hand up for Chris (G & T teacher) and this is awful. But this afternoon his behaviour was awful to Martie when seats were changed and I got a call from mum to complain because Billie was hysterical. I explained the circumstances and was told (by his mother) that children this age behave like this and that Martie stinks and gets into trouble (neither are true). His mother wants Billie moved to Year 5 for a trial and I will speak to Dallas (Deputy Principal) and pass this on. I spoke to Sidney (Stage Coordinator) and she was supportive. I cried" (Diary Y4 T3 2003, 150).

- Week 7, Sunday: "Billie was not at school all week - pneumonia - but I have been very upset since Wednesday when Dallas told me she was going to give him a trial in Year 5 (Postscript: This in fact did not occur, following Dallas's consultation with Chris - placing him in the other Year 4 class was also considered but not done - Dannie was not happy to have him, I don't know if that was the deciding factor. The decision to leave him in my class was never explained). Billie has shown no giftedness in mathematics...His results all year have borne this out. He tries to cover up his inability to understand and will never ask for help (covers up answers when I walk by). I think he feels threatened by my knowing he has struggles (and is not gifted in this area) (Diary Y4 T3 2003, 176-178).
- Week 7, Saturday: "The situation with Billie was just awful - he had a dummy spit Monday - and the seeming lack of support from Dallas in particular was very distressing. Chris was helpful. Thankfully good news on...[my daughter's medical test results]...has helped a lot - I felt like a load had been lifted from me and I feel a lot more resilient on the Billie front. I have decided to stop allowing the passive aggressive stuff. He will have the same expectations as others. He is not going to come to like me but he will be respectful or get the same response as anyone else if they act that way" (Diary Y4 T3 2003, 225).

Teacher/student relationships

With the exception of Billie, my relationship with all of the students in my home class and my English and mathematics groups had developed warmly by this stage of the year. This is evidenced in the video-taped lesson (Video-notes 25.9.03, 21) where students were keen to share their successes (Video-notes 25.9.03, 5), share a joke (Video-notes 25.9.03, 7), join in discussions (Video-notes 25.9.03, 7, 9, 17) and ask for help (Video-notes 25.9.03, 13, 15). The atmosphere in the classroom was relaxed, my interactions generally encouraging (Video-notes 25.9.03, 5, 17) and students responded quickly to my requests for their attention (Video-notes 25.9.03, 3, 11, 15).

Parent/teacher interactions

Relationships with parents were very good, with regular parent helpers assisting with reading and art. Several activities in the term involved parents coming into our classroom and the responses were always positive (Diary Y4 T3 2003, 276, 282, 287). Parent/teacher interviews in Week 3 went smoothly with no complaints or problems. Even with the problems Billie was experiencing, my relationship with his mother was friendly. Her reaction to Billie’s behaviour after being seated next to Martie clarified some of Billie’s behaviour but while she was obviously distressed by the continuing problems Billie was experiencing, she remained cordial in her dealings with me.

Safe environment

The provision of a safe environment continued to be an important priority for me in my teaching. Hence, despite my fears of the possible consequences of calling Billie to task for his inappropriate behaviour, I chose to be consistent and fair and for Martie’s sake deal with Billie’s inappropriate behaviour. However, I must acknowledge that for Billie my classroom was not perceived as safe. He was gifted in English, but while he was in the top ability group in mathematics he performed in the middle to the bottom of that group. He seldom joined in discussions voluntarily, often completed a textbook page and started reading a novel, although his work often indicated he did not understand what he was doing, and tried to cover this up, never asking for help (Diary Y4 T3 2003, 178).

Support

While I had a warm relationship with other teachers on my Stage as well as the STLD and G & T teacher who resided in our building, I did not have a relationship of trust with a more experienced staff member who might have offered support and advice. In the circumstances, I felt that the nature of the problem with Billie made it inappropriate to talk about it with others unless they were involved. Both Dannie (the other Year 4 teacher) and Chris (G & T teacher) were supportive in their feedback when they were brought into the issue when asked for their input by Dallas (Deputy Principal). However, I was nonplussed by not being included in the decision making process, an indication that I was held responsible for the problems, as well as receiving no notification nor given an explanation as to why Billie was not moved out of my class. As an inexperienced teacher this whole experience had been overwhelming, undermining my confidence in my abilities and leaving me feeling undermined as a teacher by my supervisor and isolated in my efforts to find a way forward. I resolved at this stage to take a firmer stand. Rather than trying to avoid problems by ignoring his passive aggressive behaviour, I was determined to make it clear that I expected the same respectful behaviour, to me and to his classmates, as I did from the other children (Diary Y4 T3 2003, 225).

Confidence in my teaching

Confidence in my teaching generally, and specifically in mathematics, continued to be an important issue this term. My self-assurance in my classroom management skills was generally good, feeling increasingly proficient in my organisational capabilities, being able to control the noise level and behaviour of the class with established routines and procedures as evidenced in the video-taped lesson (Video-notes 25.9.03, 3, 11, 13, 15, 17, 19, 20, 24, 27).

In terms of mathematics, I was coming to terms with the content and reflecting on those activities that were helpful or needed improving to more effectively scaffold students' learning (Program Y4 T3 2003, 176, 202, 221, 261, 263, 265, 283, 316). I was aware of how far short I had fallen in developing the elements of best practice in mathematics education in my own practice. Due to the overwhelming workload, which allowed so little time for individual lesson preparation, I had failed to provide non-routine or multi-solution problems as a basis for students to engage actively with the mathematics (Booker, 1999; Clarke, 1997) or develop a mathematics discourse community where students not only did mathematics but expected to share and justify their solutions and to support these discussions by listening to others and valuing each others' input (Cobb et al., 1993; Groves & Doig, 2004; Johanning & Keusch, 2004). In reflecting on my video-taped lesson in Week 10 I commented: "The introductory session for volume was very teacher directed again. I find it very hard to let things be discovered and discussed. I need to work on this. I suspect it takes very precise planning about the sorts of things I might ask the children as well as the tasks I set them. I simply do not have more time to plan my lessons. I am very time poor, exhausted frankly" (Video-notes 25.9.03, 22) and "I needed to get the children to show what they had done to get their results rather than simply tell them what the problems might be" (Video-notes 25.9.03, 25).

I struggled with how to provide opportunities for students to develop their own algorithms in the process of increasing their conceptual understanding of the operations of addition, subtraction, multiplication and division, while ensuring they grasped an understanding of the algorithms as a basis for their work in Years 5 and 6. At the end of the term I reflected: "The operations and associated algorithms are going quite well - but there has been little opportunity for children to develop their own algorithms leading into the need for an efficient algorithm (in fact, the formal algorithm for addition and multiplication was introduced in Year 3). The structure of the program is too time restricted for this. Therefore, many children are following a procedure (some seeing the connection with MAB addition and subtraction) and some are playing with numbers" (Program Y4 T3 2003, 333).

I also struggled to overcome students' difficulties in grasping a procedural understanding of trading and the commonly accepted algorithms. At the end of Week 9 I recorded: "I feel I have failed in implementing active learning strategies, how to do it while introducing and reinforcing trading and trading marks for both + and - is difficult. I don't know how to do it. It's OK for Space and Measurement, it's Number that is difficult while covering content, especially algorithms and preparing the children for higher mathematics. I felt I was helpful in highlighting the problem lots of children are having with subtraction.

E.g. 44 -
7
43

I reminded the children that "maths makes sense" and encouraged them to estimate the answer first and check if their answer makes sense i.e. 44 take away 7 can't possibly be just 1 less. I might pursue this next term as a priority. I can't think of any other way. How do you overcome the 'playing with numbers' rather than the numbers and symbols representing what you do with them?" (Diary Y4 T3 2003, 292-306). In my program I recorded: "Addition with trading is going very well though many children still struggle with subtraction with trading. For example they commonly make this type of mistake,

41 -
3
42

I might introduce the terms 'trading up' and 'trading down' to help them. I have encouraged them to work it out in their heads then check their answers so that they don't make this common type of error" (Program Y4 T3 2003, 311-316).

The difficulties with Billie, detailed earlier, led to feelings of failure and came at a particularly bad time in terms of my concerns for my daughter's health (Diary Y4 T3 2003, 180). In Week 7 I wrote: "A ray of sunshine in an otherwise tough few days - starting school today was a real effort - my concerns for [my daughter's health and well being] are exacerbated by feeling a failure with Billie - I had a mother of a child at the school, but not in my class (I don't know her name, but I see her often when she helps out at the uniform shop which is just outside the glass door leading from my classroom to the library), tell me that she watches me and what a terrific job I am doing. I thanked her and told her I needed to hear that today" (Diary Y4 T3 2003, 207).

Behaviour management

Behaviour management was not a major concern this term and my confidence in my ability to manage day-to-day classroom incidents had increased. This was evident in the video-taped lesson where I was confident with my abilities to operate effectively in the informal classroom environment (Video-notes 25.9.03, 24), I could plan for possible problems and make efforts to avoid them (Video-notes 25.9.03, 11), gain the attention of the whole class when required without fuss (Video-notes 25.9.03, 3, 11, 15) and organise students to move from one activity to another quickly and with growing ease (Video-notes 25.9.03, 17).

Interestingly, it was only in this term that I started to view the problems with Billie as a behaviour management issue that I was unprepared for and started to look for books that might help me in finding a way forward in dealing with him. The difficulty was that I could find nothing that described this type of behaviour. I then resolved to treat his disrespectful behaviour in the way I would treat more blatant disrespect and get over my own desire to be liked (Diary Y4 T3 2003, 225). In reflecting back on this, if viewed from the perspective that a didactical contract (Brousseau, 1984) was established with the class in the early weeks of Term 1, where my expectations of student behaviour were established and students understood and accepted these expectations, forming their own reciprocal expectations of me as their teacher, Billie had refused to enter into this contract. His resulting behaviour challenged the contract in terms of my role as his teacher and his role as a member of the class.

Discussion

Discussion was a common part of mathematics lessons, regularly programmed to allow students to share the results of their investigations or problem solving (Program Y4 T3 2003, 78) and to develop students' understanding of a focus idea (Program Y4 T3 2003, 157, 162, 246, 248-249, 300). However, as in previous terms, discussions were often teacher dominated (Video-notes 25.9.03, 7, 22, 25). In introductory discussions I found it difficult to issue a challenge without giving hints or directions on how to go about it (Video-notes 25.9.03, 9, 22). In closing discussions I struggled with allowing students to share their results without telling them what they needed to know. In reflecting on the video-taped lesson I wrote: "I think the closing time could have been more worthwhile if I had focused more on the notion of 'precision'. I needed to get the children to show what they had done to get their results rather than simply tell them what the problems might be" (Video-notes 25.9.03, 25). Marking textbooks was often an opportunity for students to share their solutions and how they got them but as I commented at the end of Week 9: "The marking of textbooks is burdensome. The children get so bored yet the opportunity to share their answers and how they got them should be valuable" (Diary Y4 T3 2003, 292).

Students still had considerable difficulty listening to other students and not enough time or effort had gone into developing this as part of our mathematics classroom culture. I commented at the end of Week 10: "Not enough time for a full discussion - though discussion is difficult - rules for discussion need to be firmly enforced. Children break off into personal conversations all the time - it is tough to break this up and stay together as a group and actively listen to each other" (Diary Y4 T3 2003, 326).

Assessment

This was not a reporting term and assessment was not an important issue. It is referred to in terms of diagnostic testing in Week 2, where students were concerned that they were being tested for reporting. Half yearly and yearly examinations at this school were quite formal and all students were entered compulsorily in the annual mathematics competition, were examined for the G & T program and undertook the textbook review tests regularly. It is within this context that they approached this review test quite competitively (Program Y4 T3 2003, 110).

Marking continued to take considerable time for me, personally, and for the mathematics class. There were many text pages that could not be marked in class time, such as that shown in the video-taped lesson, because the range of answers was too diverse to mark as a group (Video-notes 25.9.03, 26). The value that might exist in sharing solutions and seeing where they might have gone wrong was lost in the boredom of the task (Diary Y4 T3 2003, 292), especially as most of the problems were routine and required nothing but an answer. Marking continued to be a considerable component of my workload and I commented after school had finished for the term: “I stayed up to 11 p.m. last night marking and still have a lot of marking to do” (Diary Y4 T3 2003, 334-338).

At the end of term in considering the approach of the final reporting term I wrote: “I feel daunted about next term - we have programming again and reporting - I actually feel scared about the effect of this on me after Term 2. I can’t wait till the end of the year” (Diary Y4 T3 2003, 340).

Mathematics resources

Mathematics resources continued to be an important part of my mathematics lessons with Year 4. However, I had become increasingly aware that providing students with manipulative materials did not ensure they understood the intended content, many students engaging with the materials but failing to make connections to the mathematical concepts. In Week 1 I commented: “Students used shorts to make rectangles and work out factors - children can do the activity but don’t necessarily make the connection with factors - it’s interesting how many activities are like this - e.g. using MAB blocks to trade successfully but not making the connection with trading marks even though they do the activity over and over again as they complete problems" (Diary Y4 T3 2003, 24).

Mathematics resources continued to be programmed to:

- support problem solving and investigations (Program Y4 T3 2003, 86, 102, 156, 167, 185, 202, 205, 206, 211, 233, 239, 249, 275, 291, 295, 301); and
- to model mathematical concepts (Program Y4 T3 2003, 120, 126, 132).

Program evaluations included:

- their effectiveness (Program Y4 T3 2003, 265, 283);
- difficulties in locating appropriate resources (Program Y4 T3 2003, 328, 331; Diary Y4 T3 2003, 23); and
- observations of how students used them and how these indicated their understanding (Program Y4 T3 2003, 147, 176, 223, 268).

Textbook use

Textbook work continued to be the basis for mathematics this term, programmed for every lesson, pages were used for all strands of the Syllabus. It was never considered ideal and comments were made regarding perceived problems, such as it being too abstract (Program Y4 T3 2003, 332) or too specific in the equipment it required to complete a page (Video-notes 25.9.03, 23; Program Y4 T3 2003, 331) and a burden to mark (Diary Y4 T3 2003, 292).

Most notably, it was now seen to be hugely beneficial in helping me to cope with a crushing work load. In programming I commented: "I have used the textbook and last year's program to program for mathematics and finally got a copy of the Teacher's Resource Book for the text which has some helpful things in it. I have found it too hard to incorporate open-ended questions and problem solving approaches with the [school] emphasis on textbook coverage. I feel overwhelmed by the amount of work required, not only in programming, so the text[book] is a life saver. I feel I am coming to terms with the content of the Year 4 mathematics course (this is true of all subjects HSIE, S& T especially) grammar too!" (Diary Y4 T3 2003, 115).

Themes

The comments "maths makes sense", "maths is about patterns", "maths isn't about tricks", "making errors in maths is not a bad thing" and "I'm interested in your thinking not the right answer" continued to be regular themes in mathematics lessons. There is only one reference to this in my diary this term, in relating my efforts to assist those students struggling with the subtraction algorithm:

"I felt I was helpful in highlighting the problem lots of children are having with subtraction.

Eg 44
-7
43

I reminded the children that "maths makes sense" and encouraged them to estimate the answer first and check if their answer makes sense i.e. 44 take away 7 can't possibly be just 1 less" (Diary Y4 T3 2003, 296-300).

I often had the students repeat these comments when they were appropriate to a learning moment and the part they played in our mathematics classroom was brought home to me when a student, who made it through to the public speaking finals, used the statement: "As Mrs Forrester says "maths makes sense"" to humorously clinch her argument.

Active learning

The analysis of the provision of active learning opportunities this term is almost identical as for Terms 1 and 2. While many activities encouraged active learning as detailed by Newmann, Marks and Gamoran (1995), many supported only lower-order thinking which, while having a place in building foundational knowledge (NSW Department of Education and Training, 2003a), should not predominate learning opportunities. At the end of Week 9 I reflected: "I feel I have failed in implementing active learning strategies, how to do it while introducing and reinforcing trading and trading marks for both + and - is difficult. I don't know how to do it. It's OK for Space and Measurement, it's Number that is difficult while covering content, especially algorithms and preparing the children for higher mathematics" (Diary Y4 T3 2003, 292-294).

Problem solving and investigations

No multi-solution or non-routine problems were posed this term. I commented at the end of Week 4: "I have found it too hard to incorporate open-ended questions and problem solving approaches with the [school] emphasis on textbook coverage. I feel overwhelmed by the amount of work required" (Diary Y4 T3 2003, 115).

Investigations no longer included multiplication facts as these had been completed in Term 2. Investigations continued in Space (Program Y4 T3 2003, 132, 167), Measurement (Program Y4 T3 2003, 211) and Number (Program Y4 T3 2003, 86, 102, 202, 239).

Group work

Group work continued this term, though it was not mentioned specifically in the program or diary as a feature of a lesson and no evaluations of group work were provided. The video-taped lesson included group work though the groups were not structured very successfully, as students broke off into pairs and a few worked alone or uncooperatively in groups (see video-taped lesson evaluation on 25.9.03).

Routine

Classroom rules and well established routines formed the basis of behaviour and classroom management as evidenced in the video-taped lesson. Students responded quickly to known cues to gain their attention and to collect and mark books (Video-notes 25.9.03, 3).

Daily speed tests continued and students were very efficient in preparing, completing and marking them (Video-notes 25.9.03, 19). In the second half of this term division facts, as well as multiplication facts, were included in the daily speed tests and greatly assisted in clarifying the relationship between multiplication and division for many students (Program Y4 T3 2003, 221, 261).

Lesson 25th September, 2003

Table 27 Year 4 25.9.03 - Coding sheet Dimension 1

Year 4 25.9.03 - Coding sheet Dimension 1 – Intellectual Quality					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
1.Deep knowledge	The content of the lesson dealt with important concepts i.e. the introduction of mL and its relationship to L, but the importance of accuracy was not dealt with well - hugely disparate results. The focus of the content was masked by this.	3	Content	The content focus was on 'big' ideas i.e. L and the introduction of mL as a unit to measure smaller volumes and the relationship between them which fitted within the Key Ideas for Stage 2 Volume and Capacity "Estimate, measure, compare and record volumes and capacities using litres and millilitres" (p. 105). However, accuracy was not dealt with well and not enough time was available at the end of the lesson to talk about this or organise further investigation to clarify it.	4
			Explicit focus	The focus was clearly introduced and mentioned several times in the lesson.	4
2.Deep understanding	The importance of accuracy was not made and students appeared to have a sense in which it was not important. This was not really dealt with – very time restricted.	2	Teaching for conceptual understanding	The lesson was structured for students to develop a sense of a mL and its relationship to the L largely through procedures referred to in the introduction to the lesson. There were too many activities (3 pages of textbook questions) and not enough time to adequately consolidate the students' understandings. The teaspoon challenge could have supported conceptual understanding of the use of a mL and how it might be measured with some accuracy if it had not been introduced by giving clues and followed up with more time for a useful discussion and or whole class investigation.	2
4.Higher-order thinking	This was difficult to assess. I don't think it was only a reproduction of knowledge, but there was no evidence of higher-order thinking.	1			
3.Problematic knowledge	Talked about L and mL and why they are used in packaging. Why students'	3	Problem solving	The tasks in this lesson were "hands-on" activities rather than investigations. The introductory	2

Year 4 25.9.03 - Coding sheet Dimension 1 – Intellectual Quality					
	results were different to each other.			session provided too many suggestions of how to go about answering the questions, even giving clues on how to go about finding the number of mLs in a teaspoon. There were too many different questions in the 3 text pages and would have been better handled if fewer questions were given and more time taken on sharing findings.	
5.Metalanguage	Use of appropriate terms. These were expounded by the teacher and drawn out in questioning from students.	3	Discussion	Whole class discussion was very teacher dominated. Student responses were assessed by the teacher rather than getting feedback from students.	2
			Written work	Only textbook work.	1
6.Substantive communication	Substantial teacher explanation and student response to questioning. Students were communicating in their groups, but this was obviously not always about the investigation.	3			
			Student reflection	There was not enough student participation in discussion to assess student thinking or encourage reflection through the knowledge that they might be required to share their insights.	2

Table 28 Year 4 25.9.03 - Coding sheet Dimension 2

Year 4 25.9.03 - Coding sheet Dimension 2 –Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	No criteria were mentioned except behaviourally.	1			
8.Engagement	Variable engagement. Some students were clearly off task at times but all students were engaged at times.	3	Motivation	The structure of the lesson was very loose and while there was variety in the textbook tasks (some requiring knowledge of notation, addition of volumes, estimates from previous experience and "hands on" activities) there were just too many things to do and it was a bit overwhelming to get through it all. Many activities were interesting or challenging, though some were not.	2
			Mathematical resources	There were too few resources for this type of lesson, although there were a lot provided. Too much time was spent sorting out resources and making sure everybody got a turn. The resources were appropriate.	3

Year 4 25.9.03 - Coding sheet Dimension 2 –Quality learning environment					
9.High expectations	Most students participated in challenging work at least some of the lesson, many for most of the time. Several students were encouraged in their risk taking contributions in the beginning of the lesson.	3	High expectations of behaviour	Off-task behaviours were evidenced in some students at different times in the lesson. These were not always evident to me at the time. Rules for classroom behaviour were displayed in the classroom and communicated several times in the lesson. When noticed, unacceptable behaviours were usually dealt with consistently and appropriately.	3
			Risk taking	Competition was evident in the speed test although it was not acknowledged by the teacher. This can cause problems for some students and it did in this class. Risk taking was evident in the introduction with quite a few students offering suggestions and they were all treated as valuable. Few opportunities were provided for risk taking at the conclusion of the lesson because of the lack of discussion.	3
10.Social support	Positive social support was shown in supportive behaviours and comments of the teacher and the group work of the students. The teacher tried to ensure that all students were actively involved in the group work, but not enough time was given to discussion time to assess the student responses to other students' explanations.	4	Social organisation	Students worked individually, as a whole class and in groups. They were directed to work in whole table groups, but many broke off into pairs or smaller groups. Most students worked with others in pairs or groups, though a few students did not join in the joint activity or worked uncooperatively in their group.	3
			Teacher's relationships	I appeared quite relaxed with the students. A positive relationship was evident with most students feeling comfortable to ask for help or bringing things they had found in their activities to my attention.	4
11.Students' self-regulation	The video recording contributed to students' off-task behaviours, but students generally completed the set questions and were involved in the investigation. This was not often done as whole table groups as directed, but all students worked with others in pairs or groups.	3	Student autonomy	All students took active roles in the investigation and many students worked quite autonomously through at least some of the lesson.	3
12.Student direction	The children had a choice of a range of resources and these were significant to the investigation. Their choices	3	Problem solving & resources	The problems were set by the textbook and not multi-solution. The students had a choice of resources and some of these	3

Year 4 25.9.03 - Coding sheet Dimension 2 –Quality learning environment					
	were based on more than preference and were relevant to the task. This was the only opportunity for the students to set the direction of the lesson.			choices were significant to the task, not simply preferential.	

Table 29 Year 4 25.9.03 - Coding sheet Dimension 3

Year 4 25.9.03 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	Students' background knowledge of L from previous lessons is referred to clearly. The use of L and mL and their use on food and drink containers are clearly referred to in the lesson. References to the use of units of measure in real life are referred to especially in reference to giving medicine and use in labelling.	5	Building on prior knowledge	The students had completed work on the litre earlier in the year and had completed a text page introducing the need for a smaller unit of measure. As detailed in 'Background knowledge' there were clear links in this lesson to real life experiences of volume. The links would have been more substantial if the discussion had made them clearer.	4
14.Cultural knowledge	N/A	1			
15.Knowledge integration	As referred to in Element 13, and Building on Prior Knowledge, there were references made to other Strands of mathematics. These were usually trivially mentioned, but the connection between grams and litres was more substantially mentioned and exploration talked about.	3	Teaching for transfer of knowledge	Several meaningful connections were made, but not clearly, between the processes students used to find a measurement and the measurement of volumes using mL and L. Poor discussion time did not allow for these connections to be more explicit.	3
16.Inclusivity	All students were involved in all aspects of the lesson, where possible exclusion occurred I made efforts to ensure this was rectified.	4			
17.Connectedness	Connections were made to giving medicine to children and adults. How much fluid would be a helpful if thirsty and lost in the desert.	3			
18.Narrative	The use of narrative occurred several times in relationship to giving medicine, eating and drinking from different containers and being thirsty in the desert. These narratives were useful in enhancing the significance of content.	3			

Reflection on the lesson of 25th September 2003

This was quite a disrupted lesson, in terms of some students needing to complete examinations from the previous day and others returning throughout the first fifteen minutes from a G & T activity. There were insufficient resources to complete all of the textbook activities and groups had to be rotated to those under-resourced activities throughout the lesson. The need to distribute and clean up large amounts of equipment and monitor the use of water, all added to the challenges of this lesson. The lesson would have been improved with: clearer expectations of quality, in terms of accuracy, prior to the activities; and more time for and student involvement in worthwhile discussion, with particular focus on the reasons for the wide range of results and the need for accuracy.

Term 4

Workload

Workload continued to be a major issue emerging from the data. Programming (Diary Y4 T4 2003, 26, 49, 80, 83), preparing for assessment (Diary Y4 T4 2003, 68, 103; Program Y4 T4 2003, 217-220), assessing (Diary Y4 T4 2003, 156, 173, 182-183, 187, 206; Program Y4 T4 2003, 226, 251-253), and reporting (Diary Y4 T4 2003, 194, 197, 219, 222) were the major chores this term. However, preparation for running the Chapel service at the end of Week 4 (Diary Y4 T4 2003, 115, 118, 124, 130, 133) and the preparation of school mathematics documents for Stage 2 (Diary Y4 T4 2003, 246, 255, 259), as well as the requirements of day-to-day planning (33 'To do lists'), teaching, marking (Diary Y4 T4 2003, 103, 164, 192, 240, 245, 254) and organising the end of year awards (Diary Y4 T4 2003, 100, 217) were very time consuming and demanding.

Workload had been such a feature of teaching full-time this year, I decided this term to quantify the number of hours I worked a week (see Table 30, p. 240). Throughout the first seven weeks of the term I recorded all the hours spent on school work and worked a range of between 55¼ hours in Week 4 to 87¾ hours in Week 6, an average of just over 66 hours per week. Additionally, in Weeks 5 and 6 my husband assisted me in marking exams and tallying results, contributing a total of 14 hours over the two weeks.

Table 30 Hours worked in Weeks 1-7 Term 4 2003

Hours worked in Weeks 1-7 Term 4 2003								
	Mon	**Tue**	**Wed**	**Thur**	**Fri**	**Sat**	**Sun**	**Total**
Week 1	11	11	12	9	13	8	8	72
Week 2	13.5	14.5	9.75	8	10	6	3	64.75
Week 3	9.25	12.25	10.5	11	12.5	0	3	58.5
Week 4	9.75	12	9.5	11	12	0	1	55.25
Week 5	11	13.5	9	11.5	11.5	10.5	0	67
Week 6	14	13	12.75	14	13.5	9	11.5	87.75
Week 7	13	12.5	9	9	11.5	0	2	57
					Total hours			462.25
					Average weekly hours			66.03

Having outlined the details of the workload this term, it would be useful to look at my diary entries over this period to engage with some of my lived experience:

- Week 2, Monday: “I felt I did poorly today in mathematics - I was not well enough prepared and was not sure of the intent of the lesson (rigid shapes and paper folding). I could have made it more challenging by providing open-ended challenges rather than copying text - but not prepared enough - just not the time with programming. Ellis (a student) said “Maths is boring” - I need to improve” (Diary Y4 T4 2003, 49).
- Week 4, Saturday: “A frantic week - chapel preparation took up so much time - I feel I am so far behind on everything else. To revise mathematics this week I provided work on an overhead which we completed question by question. I then photocopied Dannie’s [revision sheet] onto overhead and we completed and marked them together as we went - very teacher directed - but time restraints are huge. So much for getting children to write their own problems - just not time to fiddle while getting what we need to cover the work. Next week is testing and assessment tasks. I don’t feel everything has been covered adequately. Thinking how I can revise again” (Diary Y4 T4 2003, 133).
- Week 6, Saturday: “I have spent 20 hours marking mathematics exams for 62 children (Dannie did English). Wal helped me and his hours are

included in the total. I have spent such a long time preparing to write reports and the thought of handwriting them is almost nauseating - I wrote or typed all day Sunday and half Saturday and both nights. Stuff up with the template for mathematics made me behind. I rang Dallas [Deputy Principal] and she advised me not to do them till Monday when they made a decision whether to print them again or not (they decided not to so I could have done them anyway). Still have more to do on the reports this week" (Diary Y4 T4 2003, 192-197).

- Week 7, Saturday: "I handed in my reports in Wednesday to Sidney [Stage 2 Coordinator] (on-time) but had a lot of re-writes. I have to say, handwritten reporting takes at least 12 hours more time [than reporting on computer] and corrections are so frustrating - I corrected one sheet four times and became almost paranoid of making a mistake when completing them. I am absolutely exhausted and feel 'flat', almost don't know what to do with myself" (Diary Y4 T4 2003, 222-224).
- Week 8, Saturday: "I thought I had finished the bulk of it but have had to do mathematics curriculum (for BOS registration) write ups to hand in by yesterday" (Diary Y4 T4 2003, 259).
- Week 9, Thursday: "Last day for students. We have presentation night tonight. The day has been quite emotional. The week has been one of Christmas activities and cleanup. I am emotionally and physically spent" (Diary Y4 T4 2003, 271).
- Week 9, Friday: "Last day for staff. We had to be at school till 12 p.m. to answer any questions about reports which were handed out last night. Last night was a good night - children were great. Lots of lovely feedback from a lot of parents. I am so glad it is finished. I feel zombie-like. Now I have to start on Christmas for the family" (Diary Y4 T4 2003, 274).
- End of the first week of the school holidays: "I was literally unable to do anything until Thursday - just pooped! Caught up with a group of primary school teachers yesterday and they are all the same - made me feel better about how I feel - maybe it's not just me" (Diary Y4 T4 2003, 277).
- Tuesday 27.1.04. "Wal had the time off between Christmas and New Year and I honestly cannot remember what we did - I did a lot of reading

(light stuff only) I think. I did shopping...between 1st and 10th of January when we went away for two weeks. We did next to nothing on holidays, read, watched the scenic views, saw movies - I really needed it - I am starting to recover - I don't know how it would be if I had to teach again full-time - I don't think I am up to it, in the near future anyway" (Diary Y4 T4 2003, 280).

Students' upsets

The only reference to student upsets this term related to a parent/teacher interview in Week 3 regarding relationship issues between two children in the class. I wrote: "One of the students is having issues with another student in the class. Mum and I talked about a way forward. I will speak to the other child, get his side and deal with any issues, making sure 'bullying' is not happening" (Diary Y4 T4 2003, 95).

No further issues occurred with Billie this term, although he was not warm in his dealings with me. I quietly challenged any passive aggressive behaviour by asking for clarification, never needing to discipline him, but making it clear that his behaviour was being noticed. I began asking to see his work in mathematics when he started to read his novel and offered feedback and help for any problems he was experiencing, despite receiving clear messages that he found this awkward. The relationship continued in this way for the remainder of the year.

Confidence in my teaching

Confidence in my teaching continued to be an issue and although there were no difficulties with Billie this term, I was still nervous of possible problems but less tentative in my dealings with him, as previously outlined. Comments relating to confidence in my teaching this term refer to difficulties in knowing how to overcome student difficulties with understanding a concept (Diary Y4 T4 2003, 226-230; Program Y4 T4 2003, 126). They also refer to my failure to teach mathematics in ways consistent with best practice. While I credited this to my workload and the time taken in programming, assessing and reporting (Diary Y4 T4 2003, 49, 68, 133), I also indicated that I did not know how to teach the formal algorithm differently than explaining, demonstrating and providing lots of practice (Diary Y4 T4 2003, 226).

The comment: “Maths is boring” (Diary Y4 T4 2003, 49), made by Ellis (a student) in Week 2, highlighted for me how far short I had come in teaching mathematics in ways that challenged and engaged the children in my class. The lesson in which the comment was made was particularly uninteresting, due to the small number of geo-strips available which allowed for teacher demonstration but fell far short of making student exploration and investigation possible (Program Y4 T4 2003, 130). However, the lesson was more tedious because I was unsure of the focus of the content because of poor lesson preparation, due to the pressures of programming (Diary Y4 T4 2003, 49). An attempt to remedy this involved making more detailed daybook entries to ensure I familiarised myself with the weekly content and clarified my understanding where necessary, an advantage for all KLAs, not just mathematics, and a benefit when sick and needing to provide the school with the day’s work (Diary Y4 T4 2003, 68).

In contemplating how to approach the need to revise for the upcoming exams and assessments, I considered Ellis’s comment and wrote “The next couple of weeks in mathematics includes a lot of revision leading to Week 5 exams. This may be dull - I can’t see how that can be helped except by getting children to write problems and putting them on the board (overheads!!) YES!! YES!! YES!!. At least then there will be ownership” (Diary Y4 T4 2003, 68). However, pressures from chapel preparation led me to abandon that approach, commenting: ”So much for getting children to write their own problems - just not time to fiddle while getting what we need to cover the work. Next week is testing and assessment tasks. I don’t feel everything has been covered adequately. Thinking how I can revise again” (Diary Y4 T4 2003, 133).

I was aware, particularly in these revision weeks, that my teaching was traditional (Diary Y4 T4 2003, 226), very much based in teacher explanation, demonstration and repeated practice using MAB materials for support. I explained: "I haven't worked out another way to teach the algorithms adequately", but was satisfied that most students had finally understood how to use the algorithms (Diary Y4 T4 2003, 226-230) regardless of whether they understood them.

Problem solving and investigations

The provision of routine problems was the basis of most of our work in this term. These were not planned for, but the compulsory nature of the textbook meant they were provided every day. Additional routine problems were also provided in division (Program Y4 T4 2003, 82, 235, 275), it was programmed for students to write their own addition and subtraction problems for the class to solve (Program Y4 T4 2003, 152-153) and routine problems were provided for revision in Week 4 (Program Y4 T4 2003, 190, 192, 218) on overhead projection film.

Investigations continued in Measurement (Program Y4 T4 2003, 106, 158-159) and Space (Program Y4 T4 2003, 114, 115, 209) and while speed tests continued, they no longer included investigations, as all tables had been investigated previously, but continued to include division as well as multiplication facts (Program Y4 T4 2003, 78, 94, 134, 181, 231, 257, 279).

In Week 7, as a result of the examination results, I decided to review division using routine and non-routine questions (Program Y4 T4 2003, 275). Non-routine questions were also used as a basis of the mathematics lessons in Weeks 8 and 9. These lessons were focused on problem solving and I had initially planned to use the resource books I had used as a basis for Year 2 mathematics (McIntosh et al., 1994; Skinner, 1990, 1998; Sullivan & Lilburn, 1997), but decided to use the problem solving sheets provided by the other Year 4 teacher for her class. The questions had no focus on particular content but focused on problem solving as a process.

The video-taped lesson on 4.12.03 was one of these problem solving lessons and while I again succumbed to my natural inclination to offer too many helpful hints rather than letting students struggle together towards a solution (Video-notes 4.12.03, 41), a problem common to teachers of mathematics (Chatterley & Peck, 1995; Hiebert & Wearne, 2003), I was reasonably happy with the lesson, commenting: “I think it went quite well, most students were actively involved and keen” (Video-notes 4.12.03, 37). However, when evaluating that lesson using elements of the NSW model of pedagogy coding scale (NSW Department of Education and Training, 2003a) I commented: “There was no focus on how to solve problems” (Dimension 1, Deep Knowledge coding notes - see Table 31, p. 249). My intention was to develop conceptual understanding, but in evaluating the lesson it became obvious to me that I had no clear focus on what concepts I was hoping to develop (Dimension 1, Deep Understanding, Conceptual Understanding coding notes - Table 31, p. 249).

Mathematics resources

The most notable issue to emerge from the data on mathematics resources this term, other than their continued place in my programming and evaluations, was the difficulties some students were having in using MAB materials to represent a whole, tenths and hundredths as well as units, tens and hundreds (Program Y4 T4 2003, 126, Diary Y4 T4 2003, 230).

Manipulative materials continued to be programmed to:

- support problem solving and investigations (Program Y4 T4 2003, 82, 106, 108-109, 114-115, 146, 158-159, 185, 206, 235);
- to model mathematical concepts (Program Y4 T4 2003, 98, 101, 138-139, 141); and
- to play games (Program Y4 T4 2003, 191).

Textbook use

The textbook continued to provide the core of the mathematics program this term, and with the exception of revision work it was programmed for every lesson in all strands. While I described the textbook as a life saver In Term 3 (Diary Y4 T3 2003, 115), because of the time and effort it saved in preparation, I commented this term on the time it took to mark: “Mathematics is always catch-up with slow workers and marking. Marking is shocking. We do it as a group but it takes so much time. I think this is the major problem with textbooks rather than problem solving - but I can’t change that here” (Diary Y4 T4 2003, 103).

Discussion

Discussion continued to be a regular part of mathematics lessons this term, but no improvement was evident in terms of discussion being less teacher dominated (Video-notes 4.12.03, 17, 25) or students behaving more appropriately in listening to their peers (Program Y4 T4 2003, 174; Video-notes 4.12.03, 11, 19, 21, 23, 25, 27), due to lack of planning and focus. In response to the video-taped lesson on 4.12.03 I commented: “I still take a very controlling role in discussion time. I know I do this because, from experience it takes a lot of time to get children to do a lot, and other children get bored more quickly. I need to work on it anyway, especially in setting classroom expectations” (Video-notes 4.12.03, 39).

Throughout the discussion in the video-taped lesson I repeatedly vocalised my thinking when assessing student responses, to model checking each others’ solutions and to avoid a simple ‘right/wrong’ response (Video-notes 4.12.03, 17, 19, 23, 31). However, as I noted in my reflections: “I had moments where mathematics thinking was acknowledged but right/wrong answers were still a focus” (Video-notes 4.12.03, 44).

Assessment

Assessment and reporting was an important feature of Term 4, being a reporting term. We have seen the workload involved was very heavy, but revision and assessment also impacted considerably on mathematics lessons (Program Y4 T4 2003, 249-253; Diary Y4 T4 2003, 103, 164) between Weeks 4 and 8, with revision also being the focus as a follow-up from assessment (Program Y4 T4 2003, 229, 251, 258, 275, 280, 296). Prior to assessment and exams, revision was programmed in division, multiplication and fractions (Program Y4 T4 2003, 179) but programmed lessons were not taught (Program Y4 T4 2003, 217-218) in order to focus on areas of need.

Revision lessons were very teacher directed and traditional (Program Y4 T4 2003, 217-218; Diary Y4 T4 2003, 133). My intentions of making revision more engaging for the children by using student generated problems (Diary Y4 T4 2003, 68) were quashed by the need to cover specific work and having no time to allow the students to write and share problems that were not necessarily ideal for revising those concepts that would be examined (Diary Y4 T4 2003, 133). Using a revision sheet Dannie had prepared, students completed questions which we then went through together on an overhead projector (Diary Y4 T4 2003, 133).

In evaluating the mathematics program at the end of the term I commented: "A lot of this term has been taken up with reporting. Week 4 - revision. Week 5 - exams. Week 6 - going over exams and assessing for outcomes that need observation and have not yet been completed. I tried early in the term to do assessment observations but could not get through them, so I have continued to do this throughout the term. Weeks 7 and 8 were revision based on exam and assessment results" (Program Y4 T4 2003, 318).

Behaviour management

Behaviour management did not emerge from the data as an important issue this term. There were references to students' difficulties listening to others in discussion times (Program Y4 T4 2003, 174; Video-notes 4.12.03, 39), with most references occurring in the video-taped lesson notes referring to the minute-by-minute interactions within the classroom (Video-notes 4.12.03, 5, 11, 13, 19-27, 31, 33, 35). One diary reference was a reminder to talk to the class about the behaviour that was expected on an excursion the following day (Diary Y4 T4 2003, 151).

Safe environment

The provision of a safe classroom environment continued to be a priority this term. It is referred to in regard to a mother's concerns about her child's relationship with another child in the class (Diary Y4 T4 2003, 95) as well as in the video-taped lesson notes (Video-notes 4.12.03, 35, 40, 43). In our lessons I endeavoured to deal quickly with any inappropriate comments or behaviours that undermined the safety of the classroom, as is evidenced in the video-taped lesson (Video-notes 4.12.03, 35). If a problem persisted it was always followed up with a conversation that endeavoured to bring the student to an understanding of the effects of their comments or behaviours and/or disciplinary action. In reflecting on the incident I wrote: "I was happy with my response to a nasty comment made to a child who was winning the game. At that time he was competing with some of the 'cool' children and winning. I work hard at making the room a safe place to make mistakes and have a go" (Video-notes 4.12.03, 40).

My reflections on this lesson echo the debates I often had with myself regarding the possibility of causing difficulties for some students as a result of my teaching decisions. In terms of some drill and practice games, which were often requested by the children, I struggled in weighing up the advantages of fun for most children with the possibility of embarrassment; to consider the students' who loved competition and protect those who felt threatened by it. I commented: "I always have a niggling feeling with this type of game that it really benefits the children who know their tables other than giving practice to the children who don't. But this is the more able class and the students get daily tables practice at home (homework) and school. I don't think I would play it with a less able group unless the tables were written on the wall" (Video-notes 4.12.03, 38). "I find mathematics is very competitive for a handful of children who want to race to finish quickest and get the right answers. While I don't want to quell their enthusiasm this can make it unsafe for others. I have worked hard at making sure this is dealt with positively but I am not convinced I am succeeding” (Video-notes 4.12.03, 43).

Lesson 4th December, 2003

Table 31 Year 4 4.12.03 - Coding sheet Dimension 1

<table>
<tr><th colspan="6">Year 4 4.12.03 - Coding sheet Dimension 1 – Intellectual Quality</th></tr>
<tr><th>Element</th><th>Coding notes</th><th>Score</th><th>Component</th><th>Coding notes</th><th>Score</th></tr>
<tr><td rowspan="2">1.Deep knowledge</td><td rowspan="2">There was no focus on a key concept – focus was problem solving – different skills and concepts incorporated. There was no focus on how to solve problems.</td><td rowspan="2">1</td><td>Content</td><td>No big ideas. While solving problems was a key competency across all Strands in the Syllabus it was not included as a Key Idea outside of the specified Strands.</td><td>2</td></tr>
<tr><td>Explicit focus</td><td>While the focus of the lesson was problem solving and this was evident, there was no clear focus on students’ strategies. I said the focus was on thinking but there was a significant emphasis on ‘right/wrong’ in the lesson.</td><td>1</td></tr>
<tr><td>2.Deep understanding</td><td>Uneven understanding evident – some students understood the intent of all problems quite easily and got a solution while others struggled.</td><td>2</td><td rowspan="2">Teaching for conceptual understanding</td><td rowspan="2">The aim of the lesson was to involve students in developing their conceptual understanding, the question is “Of what?” Perhaps a focus on students’ strategies and using these to scaffold the solving of other problems might have been more helpful and/or developing a problem solving approach along the lines of Polya (1957), drawn from student strategies. The coding does not accommodate the form this lesson took.</td><td rowspan="2">1</td></tr>
<tr><td>4.Higher-order thinking</td><td>The questions required higher-order thinking to complete successfully, though a considerable group struggled to understand them and/or get a solution for them.</td><td>2</td></tr>
<tr><td>3.Problematic knowledge</td><td>Many problems had more than one solution. They had multi-solution paths. However, in my efforts to limit student frustration and scaffold understanding for those struggling I sometimes stepped in with hints and clues.</td><td>3</td><td>Problem solving</td><td>The problems were not meaningful, they were challenging and more like problems from a puzzle book. They built on prior knowledge in lots of areas of mathematics but not on prior knowledge of problem solving (for its own sake as opposed to solving problems in the context of a particular content area to build conceptual understanding).</td><td>2</td></tr>
<tr><td rowspan="2">5.Metalanguage</td><td rowspan="2">‘Consecutive’ – not explained well. ‘Rectangles’ – brief explanation of them given because one student struggled with a shape being a rectangle if there were other shapes inside it.</td><td rowspan="2">2</td><td>Discussion</td><td>Discussion time was lengthy and covered a lot of different problems. Students put their solutions up on the board, but I did most of the explanations of what they had done and gave most of the feedback.</td><td>3</td></tr>
<tr><td rowspan="2">Written work</td><td rowspan="2">The students used their grid books and the sheets provided. They were asked to show their solutions and how they got them, but while many showed their solution attempts and some their workings, none showed their thinking.</td><td rowspan="2">3</td></tr>
<tr><td>6.Substantive communication</td><td>This occurred but was teacher dominated and there was not a lot of student interaction. There was also written communication and a few</td><td>2</td></tr>
</table>

Year 4 4.12.03 - Coding sheet Dimension 1 – Intellectual Quality					
	students showed thinking, but not many.		Student reflection	Opportunity was given to reflect in their grid books by showing their thinking but it was not properly followed up as important in the lesson. The students' part in the discussion involved putting up solutions, and little more, so reflection was not supported very well.	2

Table 32 Year 4 4.12.03 - Coding sheet Dimension 2

Year 4 4.12.03 - Coding sheet Dimension 2 –Quality learning environment					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
7.Explicit quality criteria	Expectations for writing their solutions as well as their thinking was given but not followed up. Very few students did more than write down their solutions or solution attempts.	2			
8.Engagement	Engagement was variable. Some students clearly engaged and enthusiastically. Some were indifferent, and some students were clearly off-task/indifferent.	3	Motivation	There was a lack of variety (where students went from one type of activity to another) in the lesson, although there were lots of different types of problems provided. Some found these interesting and challenging, others found them uninteresting and/or difficult. For those interested the pace was fine, but others were bored.	3
			Mathematical resources	Drawing and writing in grid books was the only resource given to the students.	1
9.High expectations	Many students participated in the challenging work at least part of the time. They were encouraged to try hard and take risks, though clues and hints were given which minimised risks.	3	High expectations of behaviour	Classroom rules were displayed in the classroom and appropriate behaviour was talked about several times in the lesson. Off-task behaviours were not always addressed.	3
			Risk taking	Lots of children took risks. The atmosphere was not stark and evaluative though mistakes were recognised and corrected. Many children (though not all) enjoyed the competitive game which involved risk taking.	3
10.Social support	Most comments I made are supportive but I made a negative comment to one student and about one student. Positive comments were directed at reluctant students though some	2	Social organisation	Individual work dominated the lesson except for discussion as a whole class and the game which included the whole class. Some students worked together in pairs by choice, but it was not teacher directed.	1

Year 4 4.12.03 - Coding sheet Dimension 2 –Quality learning environment					
	students were overlooked. The possibility of negative student comments in the tables game at the end of the lesson was challenged with the reminder of the consequences of making negative comments to other students.		Teacher's relationships	Positive teacher/student relationships were evident with nearly all students although negative comments were made regarding the behaviour of some students.	3
11.Students' self-regulation	Many students demonstrated autonomy and initiative in the lesson, but the lack of structure led to many students being off-task for at least parts of the lesson.	2	Student autonomy	Opportunities were given for problem solving but many students were off-task. Some students showed autonomy and initiative in their mathematical behaviour.	2
12.Student direction	Students had direction in their choice of solutions strategies. No mathematical resources were provided (the questions did not require them – the ones on the previous day had involved resources for some problems). Students used drawing and writing if they chose to help solve the problems.	1	Problem solving & resources	No mathematical resources were made available. Multi-solution problems were given and the opportunity to record their solutions and thinking involved some choice. However, many students needed assistance to understand what was required of them.	2 (category 1 & 3 suited most).

Table 33 Year 4 4.12.03 - Coding sheet Dimension 3

Year 4 4.12.03 - Coding sheet Dimension 3 – Significance					
Element	**Coding notes**	**Score**	**Component**	**Coding notes**	**Score**
13.Background knowledge	There was mention made of yesterday's lesson of problem solving.	2	Building on prior knowledge	Students needed a variety of prior mathematical experiences to complete the problems and the problems were appropriate to their ages and abilities. They did not have prior problem solving knowledge in the context of these types of problems (as opposed to problems given to support the development of conceptual understanding of particular content).	2
14.Cultural knowledge	N/A	1			
15.Knowledge integration	No connections were made with other KLAs.	1	Integrated lessons	The content was not the focus of the lesson, in fact the process was more the focus than specific content. However, the processes the students used were not clearly drawn out and meaningful connections between the processes and content	1

Year 4 4.12.03 - Coding sheet Dimension 3 – Significance					
				(problem solving) were not made.	
16.Inclusivity	Some students excluded themselves when they could and it was not picked up by me. Most chose to be involved. This was only based on students' motivation in this lesson.	3			
17.Connectedness	No connections were made to anything outside the classroom although these types of problems are encountered in puzzle books and, therefore, have some real-life relevance.	1			
18.Narrative	Not used.	1			

Reflection on the lesson of 4th December 2003

Interestingly, my reflections immediately following this lesson, were very different than reflecting on it in the light of the both the NSW model of pedagogy (NSW Department of Education and Training, 2003e) and the framework of effective mathematics teaching developed for this project (Tables 10, 11, 12, pp. 118-122). The most notable problem in the lesson was the lack of focus on either a key mathematical concept or the development of problem solving skills. Some students found the problems engaging and challenging, while several found them outside of their normal experiences of mathematics and struggled and/or disengaged. The lesson would have been improved through: discussion of students' approaches to solving the problems; a clearer focus on developing problem solving skills utilising Polya's (1957) four step problem solving plan; and scaffolding the development of these skills through appropriate questioning and group work (Souviney, 1994).

Action Research focus

In Term 1 I had decided that, due to the impact of the heavy workload on my lesson preparation and planning, I would not add extra pressures by focusing on particular components of best practice in mathematics education. My aim in mathematics would be to come to terms with the Year 4 content and identify associated student thinking (Diary Y4 T1 2003, 480). In reflecting on the year I concluded: “I feel I am a lot more comfortable with the Year 4 content and have gained insights into common ways students approach some of the content, e.g. Some students will still subtract the little number from the big number (in a column) rather than trade, or trade whether they need to or not, to answer a question. In an ideal world I would teach this grade again (maybe twice more) to consolidate my content understanding and give myself the opportunity to focus on developing a more problem solving classroom, incorporating more features of best practice consistently and thoughtfully” (Diary Y4 T4 2003, 283).

At the end of 2002 I had ranked myself informally against criteria associated with best practice in mathematics teaching. Likewise, in reflecting on my teaching in 2003 I concluded: “I have developed:

- useful behaviour management skills using both positive and negative reinforcement, but focusing on the positive, with Year 4 children (9);
- a safe risk taking environment where children feel safe to share their answers and thinking (9);
- my understanding of the content of Year 4 mathematics (7);
- my understanding of the possible ways Year 4 children will approach different aspects of mathematics and their mathematical thinking (4);
- a problem solving approach to enable Year 4 children to ‘discover’ the mathematics (3);
- a culture of “talking about doing mathematics” in this Year 4 class (4);
- a culture of participating cooperatively in a group to solve problems and present your solutions to others (3); and
- a culture where mathematics is not about getting ‘right’ answers but about the process of getting an answer (6)” (Diary Y4 T4 2003, 287-295).

CHAPTER SEVEN

Comparison and evaluation of the early years of teaching mathematics

Introduction

Chapters 5 and 6 of this thesis analysed and discussed the different issues that emerged from the first two years of teaching primary school mathematics. They noted the perceived importance of these issues, term by term over the two years, within the differing contexts of teaching only mathematics in the first year and teaching across all KLAs in the second year. Six lessons were video-taped over the course of the two years, three in the first year and three in the second year of teaching, and analysed using the NSW model of pedagogy and review of the mathematics education literature utilising two instruments: The coding scale overview of the 18 elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) (Tables 7, 8, 9, pp. 115-117); and the coding guidelines developed from the mathematics education literature (Tables 10, 11, 12, pp. 118-122). The elements of quality teaching, as detailed in the NSW model of pedagogy and the associated components of effective mathematics teaching, were evaluated in the video-taped lessons and coded using numerical values between 0 and 5 with associated coding comments included.

This chapter will compare, contrast and evaluate the main issues identified in Chapters 5 and 6. These included behaviour management; textbook use; workload; the introduction of non-routine problems and investigations; the use of manipulative materials; the scaffolding of classroom discussions; difficulties with assessment and reporting; student/teacher relationships; and confidence in myself as a teacher. The context in which they emerged from the data and the changes that occurred in their nature and importance over the period of the two years will be highlighted. My assessment of the development of my teaching, as evidenced in the six video-taped lessons, will be considered. A discussion of these issues and developments, in light of the literature pertaining to mathematics education, beginning teachers and quality teaching, will be undertaken.

My goals

When recording the long term goal of developing my ideal pedagogy in 2002 (see Table 34, p. 255) I drew on an ideal vision of myself as a teacher of primary school mathematics. The notion of a novice teacher holding a vision of 'self-as-teacher' is common in literature pertaining to both preservice and beginning teachers (Bullough & Baughman, 1993; Bullough et al., 1989; Kagan, 1992; Lundeen, 2004; Schuck, 1996) and my long-term goals embodied this vision as it related to primary school mathematics.

Table 34 Visions of self-as-teacher of primary school mathematics

Visions of self-as-teacher of primary school mathematics	
Original - result of prior to university experiences	**New - result of preservice course**
Short and long term I would teach mathematics by: ► explaining and demonstrating mathematical concepts and procedures. ► students practising numerous examples. ► supplementing this instruction by the use of manipulative materials to support students' understanding.	In the long term I would teach mathematics by: ► Providing non-routine problems to stimulate student thinking and encourage students to work out their own ways of solving these problems and sharing these different ways. ► Encouraging a way of doing mathematics which does not focus on right/wrong solutions but focuses instead on thinking, problem solving, testing, rethinking, explaining and justifying. ► Using praise for social behaviour rather than mathematical activity. Instead I want to ask stimulating and probing questions to scaffold further thinking and, therefore, learning. ► Establishing my role in the class as a facilitator of mathematics learning but not the judge of right and wrong answers and procedures while maintaining a respectful learning environment for myself and my students. ► Establishing and maintaining effective group work (Diary Y2 T1 2002, 8-12).

This vision was the outcome of my preservice teacher education courses, particularly my Bachelor of Education honours research which focused on the reform-oriented practice of primary school mathematics teaching. In contrast to my school education, which was grounded in traditional teaching practices, these courses embodied a different vision of mathematics teaching which encouraged the development of conceptual as well as procedural understandings of mathematics through problem solving and investigational activities. My first hand experience of this type of teaching, in preservice course tutorials, was supported by my reading of mathematics research literature. However, the only experience I had of this type of teaching in the primary school classroom, other than reading the literature, was watching a video of this type of teaching (NSW Department of School Education Western Region, 1989).

Prior to my preservice teacher education course, I originally saw myself teaching in a very similar style to the mathematics teaching experienced in my own school education; me, as the teacher, explaining and demonstrating and the students practising numerous examples, although, unlike my own primary school education, this would have been supplemented by the use of manipulative materials to support students' understanding (Table 34, p. 255).

In comparing these visions of self-as-teacher (Table 34, p. 255) it is obvious that my original vision of self-as-teacher was considerably simpler than the vision transformed by my preservice course. The original vision was teacher-centred, less focused on understanding student thinking, involved thoughtful planning and the ability to provide clear demonstrations and explanations, all aspects of teaching with which I was familiar. Having experienced this type of teaching for thirteen years of schooling, compared to two semesters of reform-oriented teaching in my preservice course, I could more readily see myself successfully undertaking the original role. I felt very uncertain about my ability to undertake the new role, unsure of even where to start. Therefore, in commencing teaching primary school mathematics in 2002, my goals for that year were, in fact, the hoped for side effects of my efforts to achieve my long term goals. Seeing my long term goals as requiring a great deal of teaching experience, I hoped the efforts to improve my teaching in 2002 would be profitable for the students in supporting the development of their understanding of mathematics, as well as establishing positive relationships with me as their teacher and encouraging positive attitudes to mathematics as a result of our lessons.

My short term goals were practical actions I decided to undertake to ensure that the first week of teaching went as smoothly as possible in terms of behaviour management, classroom organisation and lesson preparation. Having a previous program I knew what I would be teaching and had the time to ensure I would be well-prepared for my lessons.

In preparing to go into the second year of teaching I did not think to revisit my goals from the previous year, although, on reflection they would not have changed. My initial concerns prior to school commencing were similar to those of the previous year, focusing on behaviour management and having adequate work prepared to ensure a positive start to the school year. However, unlike the previous year I felt under-prepared, my preparation having been inadequate due to limited mobility and inexperience.

My first concern - behaviour management

When commencing teaching in 2002 I had previously experienced three professional experience placements, each a month long. I also taught RFF (Relief from face-to-face) lessons with a variety of grades, several hours a week, for approximately two years prior to the commencement of this study. While I had encountered several difficult students in this time, as well as some classes that were more challenging than others, none of my experiences were negative, although they were always demanding. Despite these experiences, behaviour management was my first concern prior to commencing teaching and in the first weeks of 2002 and was surpassed in importance, only by my feelings of not being prepared in the early days of 2003. The length of time behaviour management retained importance in my reflections lessened in 2003. This may be due to my increased confidence, the speedier establishment of behaviour management routines due to teaching full-time and/or the priority given to other concerns in this second year of teaching.

My attitudes to behaviour management were consistent with the findings of research, being the aspect of teaching in which I was most fearful of failing, seeing it as the linchpin of effective teaching (Schools Council, 1990; Stronge, 2002) and the factor most influential in establishing myself as a competent teacher to myself (Flores & Day, 2006) and others (Britzman, 1986). My experiences concur with Britzman's findings that teachers judge each others' competence on the basis of classroom control (1986).

In line with the literature on beginning teacher concerns (Friedman, 2000; Gratch, 1998; Veenman, 1984), behaviour management issues were my first priority in the early weeks of teaching. However, this is not only true of beginning to teach in 2002, it became evident again in changing from part-time to full-time teaching in Term 4, with a class of largely unfamiliar children. It was also true in my earlier experiences teaching RFF and in my full-time year of teaching in 2003. In fact, in the four years of part-time teaching since the project finished, concerns regarding behaviour management recur at the beginning of every teaching experience with a new class and settle when I feel I am familiar and confident in handling the behavioural challenges each class presents. Whereas in my earlier teaching I was fearful of failing to meet these challenges, in recent times there is confidence, that with experience in a particular situation, I will manage a way forward. This is coupled with a sense of frustration that some behaviour problems are constant and continuous challenges, tedious to deal with, make teaching more difficult and affecting the quality of learning for all students. This appears to be in line with the findings of Martin, Chiodo and Chang (2001), in their case study of two beginning teachers over the first three years of their teaching career, whose concerns for behaviour and classroom management never disappeared, but became part of the daily mix of teaching, where problems arose, they dealt with them and then got back to teaching.

Berliner (1988) described the need for novice teachers to build a taxonomy of student errors in thinking in order to support students' learning in a reflective, responsive manner. I surmise that this is also true in behaviour management, requiring the beginning teacher to build a taxonomy of student behaviours to assist in the recognition and diversion of potential problems and suitable responses to different behaviours. The Year 4 student, Billie, evidenced behaviour that did not fit within my taxonomy of student behaviours and I had no idea of how to deal with it effectively. My decision to treat the situation as a behaviour management problem led me to research it as a 'type' of behaviour without success, but it also led me to respond to behaviour that I labelled 'passive aggressive' in an active way, rather than hoping it would go away by ignoring it.

Behaviour management was the focus of a large part of the thinking I undertook to manage the moment-by-moment functioning of the classroom. Classroom control required constant planning, monitoring and action in an effort to avoid difficulties and scaffold appropriate behaviour. While some of this planning was done prior to lessons, in terms of lesson structure and activities, much of it took place from moment-to-moment; planning to avoid problems, monitoring behaviours and activities, positively and negatively reinforcing appropriate and inappropriate behaviours and moving between these mental activities and associated actions in constant consideration of student behaviours, perceived needs and planned activities. Jackson (cited in Desforges & Cockburn, 1987) estimated that primary school teachers take part in 200-300 exchanges an hour in the classroom. It is in this context of rapid classroom life that behaviour management decisions are made and the advantages of established routines and expectations are evident. These routines and expectations need to be established with every class, establishing a didactical contract (Brousseau, 1984), where students become aware of the teacher's expectations of them and form their own expectations of their teacher. The importance of this, as the foundation of a positive learning environment for the remainder of the year, no doubt contributes to my focus on behaviour management in those early classroom experiences with every new group of children.

Differences in teaching mathematics in 2002 and 2003

The major constraints in implementing components of best teaching practice in mathematics lessons were markedly different in the first year teaching part-time and the second year teaching full-time and are very much related to the part-time and full-time hours that were worked.

In the first year of teaching, after establishing classroom behaviour guidelines and expectations, my focus turned to improving my mathematics teaching and the remainder of the year saw that, despite inexperience, I was able to achieve some success in the development of elements of pedagogy in the direction of best practice.

In entering my second year of teaching primary school mathematics, I was envisaging a tough year. I expected the heavy workload, having undertaken professional experience placements and working with several beginning teachers, I had seen the hours they worked. In my own part-time STLD position I had worked many hours more than those for which I was being paid. Having said this, the relentlessness of the workload, coupled with the stresses of teaching, affected me in ways for which I was unprepared. Whereas, I had expected to struggle to find time for adequate mathematics lesson preparation, I had not expected to struggle with diminishing energy levels, both physically and emotionally, that made coping with classroom teaching increasingly burdensome. Therefore, my efforts to improve my mathematics teaching were undermined, not only by my difficulty in finding the time for individual lesson preparation but, by my reduced ability to willingly put myself in teaching situations which would require high level thinking, in terms of my knowledge of mathematics and pedagogy, when the requirements of conducting less adventurous lessons placed pressure on my already stretched capacities. In these circumstances my focus moved from improving my mathematics teaching to surviving, physically and emotionally.

Textbook use

The compulsory use of the textbook emerged very clearly from the 2002 data. In this context the textbook was, at first, an obstacle I did not know how to overcome due to my inexperience. Having never seen an alternate approach to teaching mathematics I floundered in knowing what to do to change my approach. The turning point came after a conversation with a well-known mathematics education academic visiting the university, who encouraged me to introduce non-routine problems while maintaining the use of the textbook. Subsequent to my early efforts to implement these changes, which will be discussed later in this chapter, the textbook was no longer an obstacle but became an irritant, taking time from those things I was keen to pursue, undermining my focus on the process rather than the product and never adequately doing the task I felt it should have been doing in providing the written component of mathematics lessons. The intense workload and its effects came out of the 2003 data. The textbook was no longer an obstacle or an irritant, though I still criticised it. It was a life saver, reducing the amount of time and energy required to prepare for and undertake mathematics teaching.

The mandated use of a set textbook series across a school is not uncommon in Australian primary schools (McNaught, 2005) and mirrors trends overseas (Cai, Watanabe, & Lo, 2002). In terms of the three independent schools in which I have taught since graduation, this has been the case, all using a textbook series compulsorily across all grades. For the group of six novice teachers I kept in touch with throughout this two years of teaching, five teaching in NSW government schools, one within the Catholic education system, textbooks were not mandated but were commonly used across all grades in their schools. Textbooks offer a sense to teachers, administrators and parents that mathematics is being planned and taught in a systematic manner (McNaught, 2005) and have become so important at some schools that they have been referred to as a pseudo (McNaught, 2005) or de facto curriculum (Cai et al., 2002). McNaught (2005) observed that while quality textbooks are usually published with teacher-manuals, which provide a range of teaching activities that include the textbook as a resource, it is not unusual for these manuals to be unavailable for teachers, as it was in my two years of teaching. Subsequently, the textbook is often used as the mathematics program. This was not true of my teaching, or of any other teachers with whom I taught in these two years. Where possible I provided activities other than those specified in the textbook to support the learning of a particular concept and the students' mathematics workbooks were used to record their solution attempts in some of these lessons. However, these opportunities were restricted by the compulsory nature the textbook, which made it much more than a teaching resource, restricting the possibility of making professional judgements regarding the most appropriate way of teaching particular content or approaching the teaching of mathematics.

Textbooks are traditionally connected with a transmission model of teaching (Alsup, 2003; Boaler, 1998; Harries & Sutherland, 1999). This focuses on a procedural approach to the teaching of mathematics and subsequently promotes a procedural rather than conceptual understanding of mathematics which has limited value when students are placed in unfamiliar situations (Boaler, 1998). This approach also focuses on the production of correct solutions rather than the thinking processes involved in coming to a solution (Wood, Williams, & McNeal, 2006) and often sees the culture of the mathematics classroom embodied in correctness, precision, prompt recall and speedy task completion (Bauersfeld, 1992). In the part-time year of teaching, difficulties were experienced in having a compulsory textbook while endeavouring to repress my natural inclinations to imitate the transmission model of teaching, with which I was familiar as a student, and to encourage students to actively engage with the mathematics, focusing on the process rather than the solution. Skills based number pages encouraged an explanation, demonstration and practice approach and this could not be overcome even when supplemented with non-routine problem solving activities. No space was provided on the pages to record student thinking and very few questions encouraged reflection on the thinking processes used to reach solutions. Marking was also compulsory and as most pages only allowed space for the recording of students' answers, no insights were given into student thinking, other than those deduced from common student errors. Therefore, marking could not be undertaken in any other way but as an assessment of right and wrong answers with a tick or a cross. In Chapter 8 discussion of potential solutions to the rigidity of this approach occurs.

While the textbook was an obstacle to making the initial changes to improve my teaching and then an irritant in my continued efforts throughout the first year of teaching, it was a welcome basis for my mathematics lessons in the second year. In reflecting on my efforts in that year, I surmise that, while my mathematics teaching fell short of my own standards, let alone those advocated by the NSW model of pedagogy (NSW Department of Education and Training, 2003e) or mathematics education literature, without the textbook the quality of my mathematics teaching would have been considerably poorer.

Workload

Workload was not an issue in my part-time year of teaching, although In Terms 2 and 4 it was recognised as a potential difficulty in regards to reporting when teaching full-time, because assessing and reporting on mathematics alone had been so time consuming. The move to full-time teaching at the end of 2002 saw the utilisation of a more traditional approach to teaching mathematics, with a greater focus on the use of the textbook. However, this was related to behaviour management issues rather than the increased workload, the only effect of which was that I organised mathematics resources on the day of a lesson instead of two days in advance.

Workload was the most important issue to emerge from the data collected in my second year of teaching. This is not unexpected, the beginning teacher literature describes novice teachers' struggles with heavy workloads (Anderson, Balding, Schuck, & Segal, 2000; Brown & Borko, 1992; McCormack & Thomas, 2003; O'Brien & Goddard, 2006; Rossmanith, 2006), historically taking on the full range of duties and responsibilities of an experienced teacher from the first day of their employment (Berliner, 1987; Huberman, 1989; Lortie, 1975), a situation that is still the norm in NSW (Rossmanith, 2006). The hours I worked in the first seven weeks of Term 4 averaged just over 66 hours a week, ranging from 55¼ hours in Week 4 to 87¾ hours in Week 6, my husband assisting me for a further 14 hours over Weeks 5 and 6. The hours worked in Terms 1 and 2 were very similar, dropping only in Term 3, although at their lowest levels they would have averaged well above 40 hours a week. Compared to the findings of Veenman (1984), Gratch (1998) and Sparrow (2000) (see Table 5, p. 93), workload appears in recent times to have become more pressing in beginning teachers' concerns, being second only to low salary levels, as one of the three main reasons given by first year teachers for leaving the profession (Jeanlouis, 2004) and with behaviour management constituted the major concerns of beginning teachers in an Australian survey of 1200 beginning teachers (Rossmanith, 2006).

However, heavy workloads are not only an issue for beginning teachers. There are growing concerns about the workloads of teachers generally (Gardner & Williamson, 2006; Naylor, 2001) with nearly 20% of Australian teachers reporting that they worked more than 50 hours per week and a further 35% between 40 and 49 hours per week in the 2001 census (Australian Bureau of Statistics, 2003) and 48% claiming to work 45 hours or more in the 1996 census (Australian Bureau of Statistics, 1997). WorkCover data indicates that workplace stress in the education sector is nearly four times the community average (McLennan, 2006) and results of an Independent Education Union (IEU) survey in both Victoria and NSW found that stress was related to the "ever increasing complexity and intensity of teachers' work…[and] the increasing hours of work" (Independent Education Union of Australia, 1997, p. 11).

'Survival' has been used to describe the initial experiences of beginning teachers for decades (Feiman-Nemser, 1983; Fuller & Bown, 1975; Huberman, 1989; Katz, 1972; Lang, 1999; McCormack & Thomas, 2003;

Ryan, 1974). However, research suggests that during this time there has been “a veritable revolution in educational policies, methods and curricula” (Endicott cited in Guthrie, 2005-2006, p. 9) and teachers’ jobs have become more complex, workloads heavier and the need to maintain intense work efforts constant (Guthrie, 2005-2006; Independent Education Union of Australia, 1997). Beginning teachers in NSW are given little, if any relief from the full duties of an experienced teacher, an onerous expectation of people who are learning a very complex job, when their more experienced colleagues are struggling to cope. If ‘survival’ described the experiences of beginning teachers in the early 70s, how can they be adequately described in 2007? When I read the literature on the survival experiences of beginning teachers, prior to this study, I saw it in terms “muddling through until it all starts making sense” (Berliner, 1988, p. 61), envisaging that experience would make the initial overwhelming workload increasingly manageable. However, my lived experience was of a relentless, crushing workload that eroded my resilience and motivation leaving me exhausted, frustrated and demoralised. The notion of ‘survival’ now holds for me the very real possibility of not surviving.

It is well documented that teachers’ mathematical content knowledge affects the quality and nature of their teaching (Brover, Deagan, & Farina, 2001; Fennema & Franke, 1992; Schoenfeld, 2000; Schoenfeld, Minstrell, & van Zee, 2000; Shulman, 1985; Yackel & Cobb, 1996) and intuitively I feel this would appear true in all subject areas. There is an attitude in the United States that primary school mathematics is “'basic', superficial, and commonly understood" (Ma, 1999, p. 146) and I have experienced this view in Australia as well, not only of mathematics but of all primary school KLA content. However, HSIE and Science and Technology topics such as the British colonisation of Australia (including an indigenous perspective), the workings of the different systems of the human body, magnets and their uses, the local community, past, present and future (including an indigenous perspective) and the workings of local government, just a few of those included in the Stage 2 curriculum, involve very specific and detailed knowledge, considerably more than bits of general knowledge gleaned from life experiences or remembered from one's own primary school education. This sort of knowledge requires considerable time and resourcing, time the beginning teacher struggles to find in preparation for teaching.

Major issues

In my first year of teaching primary school mathematics there were no other major issues to emerge from the data than behaviour management and matters related to my efforts to implement best teaching practice, matters that are discussed elsewhere in this chapter. However, the second year of teaching saw the difficulties of one student in my class and the continuing health concerns of my daughter have considerable impact on my emotional well-being. Student problems and the demands of personal lives are both issues that have been identified as common to beginning teachers (Gratch, 1998; Sparrow, 2000; Veenman, 1984) and have stayed consistent over time as problems for beginning teachers (Table 5, p. 93).

The persistence of the difficulties experienced with one particular student undermined my confidence in myself as a teacher. Floundering in my efforts to find an effective solution, with no advice or assistance from my supervisors, being excluded from the decision making process and not being advised of decisions further undermined my confidence and left me feeling vulnerable and alone. In combination with the fatigue and pressure caused by the heavy workload and the stress and uncertainty triggered by my daughter's illness, my ability to function effectively was reduced.

Having no mentor at the school, there was no experienced teacher with whom I could comfortably share these personal and professional problems with the confident expectation of being supported in finding a way forward, rather than judged. Research indicates that positive mentor/novice relationships, where the mentor has no role in teacher performance evaluations (Ewing, 2001) and offers emotional as well as technical support (Kelley, 2004), play a significant role in teacher satisfaction and, therefore, retention rates (Ewing, 2001; Kelley, 2004). The implications of this will be considered in Chapter 8.

Efforts to improve my teaching

The efforts to improve my teaching differed considerably in my first and second years of teaching, due to the part-time and full-time workloads of those years. The approach taken in the first year of part-time teaching was to identify the most pressing need each term, in connection to improving my teaching to support the development of students' conceptual understanding, and to make appropriate changes in my teaching. My efforts in Term 1 centred on establishing behaviour management routines and identifying the area that would benefit most from my efforts to change. In Term 2 my focus was on the introduction of non-routine problems and the introduction of basic addition and subtraction fact investigations. In Term 3 my attention centred on the improvement of class discussions and in Term 4, to improving the processes and efficiency of assessing and reporting. The implementation of non-routine problems, investigations and improvement of class discussions involved the explication of clear guidelines for behaviour in all of these activities, along with the normal classroom expectations of behaviour. These efforts evidenced success, especially in terms of the improvement evident in the students' identification and explanation of patterns and the mental strategies they used in solving problems and identifying number facts and to a lesser degree in the reduction in time spent on assessing for reporting.

Although it was my intention to continue with this pattern in the second year of teaching, it became apparent in Term 1 that my first priority would be coming to terms with the Year 4 mathematics content while trying to generally implement components of best practice in my teaching. The data, in terms of my program, diary, video-taped lesson notes and the evaluation of the video-taped lessons, indicate that there was little improvement to the quality of my teaching in that year. However, there is evidence of sustained communication in the classroom about mathematics. The study was not set up to quantify the effectiveness of my teaching in terms of student learning and it should be said that generally my students performed well in the assessable tasks and formal examinations used in this year.

The video-taped lesson evaluations

Video-taped lessons were not planned for, in terms of selecting one strand of the Syllabus as a focus or putting extra preparation into the lesson to ensure that they were my best efforts. The sample of lessons was one of convenience, occurring at times that were most suitable, in terms of workload and the availability of assistance, for the operation of the recording equipment. In following the development of my teaching, as evidenced in the video-taped lessons, it needs to be remembered that at the time of teaching I was seeking to implement components of best mathematics teaching practice from a vision of quality mathematics teaching practice described in mathematics education literature and detailed in the work of Clarke (1997; 1999). With the subsequent introduction of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) and the publication of B. and D. Clarke's research on identifying the components of effective mathematics teaching in K-2 (Clarke & Clarke, 2004), an effort was made to align the generic dimensions and elements of the model with the components of effective mathematics teaching practice.

The analysis of the six video-taped lessons using the coding scale overview of the 18 elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) (Tables 7, 8, 9, pp. 115-117) and the coding guidelines developed to analyse the components of effective mathematics teaching based on the mathematics education literature with a particular focus on the work of D. and B. Clarke (Clarke & Clarke, 2004; Clarke, 1997) (Tables 10, 11, 12, pp. 118-122), is the basis of the following discussion. The NSW model of pedagogy coding scale overview (NSW Department of Education and Training, 2003a) was designed to be used by teachers, individually or in groups, to support their professional learning and practice through reflection and analysis, or to guide planning. It was not intended to be used for external assessment and a warning is issued that “any attempt to use it for this purpose has the potential to undermine its value in supporting teacher professional learning and dialogue” (p. 5). In this context it has been used as one of two instruments to evaluate the development of my teaching, for purposes related to my own professional learning and practice. It is my own practice on which the assessments have been made and my readers are the group of teachers to share in my reflections and analysis.

Remembering that these lessons are not necessarily representative of the development of my teaching over the two years, as snapshots of my teaching they hold some interest. They evidence improvement of my practice in the first year, teaching part-time, consistent with the focus of my efforts, as well as a lack of improvement in the second year, teaching full-time, consistent with my struggles to survive.

Over the course of the three video-taped lessons, taught in the first three terms of 2002, the most improvement occurred in the Intellectual Quality Dimension (Dimension 1) of the quality mathematics teaching framework (see Table 35, p. 270), although developments across the three dimensions, in both the elements of the model and the components of effective mathematics teaching, are also evident. While more improvement is apparent in relationship to the components of effective mathematics teaching, it was not restricted to either problem solving or discussion, although development in these was considerable over the three lessons (Table 35, p. 270).

The improvements in the components of Teaching for Conceptual Understanding, Student Reflection and Student Autonomy are associated with the efforts to improve my teaching through the introduction of non-routine problems and the development of worthwhile class discussions. This is due to the Coding Guidelines for the Components of Effective Mathematics

Table 35 Development of teaching in 2002 based on lesson evaluations

Development of teaching in 2002 based on lesson evaluations							
Dimension 1							
Element	1.5	27.6	12.9	**Component**	1.5	27.6	12.9
1.Deep knowledge	3	4	3	Content	3	5	4
				Explicit focus	3	3	4
2.Deep understanding	3	3	3	Teaching for conceptual understanding	3	4	4
4.Higher-Order thinking	3	3	4				
3.Problematic knowledge	3	3	4	Problem solving	2	4	4
5.Metalanguage	3	2	2	Discussion	2	3	4
				Written work	3	1	3
6.Substantive communication	3	3	4				
				Student reflection	2	3	3
Total D1	**18**	**18**	**20**		**18**	**23**	**26**
Dimension 2							
7.Explicit quality criteria	3	4	3				
8.Engagement	4	3	4	Motivation	3	3	4
				Mathematical resources	3	5	4
9.High expectations	3	4	4	Behaviour	3	4	4
				Risk taking	3	4	3
10.Social support	4	3	4	Social organisation	4	3	2
				Teacher/Student relationships	4	4	4
11.Student self-regulation	3	2	4	Student autonomy	3	3	4
12.Student direction	3	3	3	Problem Solving & resources	2	3	3
Total D2	**20**	**19**	**22**		**25**	**29**	**28**
Dimension 3							
13.Background know	3	3	3	Building on prior knowledge	3	4	5
14.Cultural knowledge	2	1	2				
15.Knowledge integration	2	1	3	Integrated lessons	3	4	4
16.Inclusivity	4	4	4				
17.Connectedness	3	1	2				
18.Narrative	2	2	3				
Total D3	**16**	**12**	**17**		**6**	**8**	**9**
Element Total	**54**	**49**	**59**	**Component Total**	**49**	**60**	**63**
Total of element and component scores for each lesson					**103**	**109**	**122**

Teaching (Tables 10, 11, 12, pp. 118-122), incorporating both problem solving and discussion into its criteria for many of the components. The associated developments in the elements of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) highlight the connections between the components of effective mathematics teaching, as described in the mathematics education literature, and the more generic elements of quality teaching, as described in the model. For example: the development of conceptual understanding is clearly related to the development of higher-order thinking; a problem solving approach to teaching mathematics obviously supports the element of Problematic Knowledge, where knowledge is seen as socially constructed and having multiple perspectives; connections are evident between the development of worthwhile discussions and improvement in the element of Substantive Communication; and activities and expectations of behaviour which encourage initiative and autonomy in mathematical behaviour also support the development of the element of Student Self-Regulation and explication of High Expectations.

In terms of the overall coding scores assigned to these lessons, the video-taped lessons in 2003, the full-time year of teaching, evidenced a disturbing trend. Starting at a level similar to the second lesson taped at the end of Term 2 2002, the scores regressed to a level approximating the score of the first lesson in 2002, to what can only be described as a very poor lesson in Term 4 (see Table 36, p. 271 and Table 37, p. 271 or Tables 31, 32, 33, pp. 249-251 for more detail).

Table 36 Development of teaching in 2003 based on lesson evaluations

Development of teaching in 2003 based on lesson evaluations							
Dimension 1							
Element	3.4	25.9	4.12	**Component**	3.4	25.9	4.12
1.Deep knowledge	4	3	1	Content	4	4	2
				Explicit focus	4	4	**1**
2.Deep understanding	3	2	**2**	Teaching for conceptual understanding	4	2	**1**
4.Higher-Order thinking	4	1	**2**				
3.Problematic knowledge	4	3	**3**	Problem solving	4	2	**2**

5.Metalanguage	3	3	**2**	Discussion	4	2	**3**
				Written work	3	1	**3**
6.Substantive communication	4	3	2	Student reflection	4	2	**2**
Total D1	**22**	**15**	**12**		**27**	**17**	**14**
Dimension 2							
7.Explicit quality criteria	4	1	2				
8.Engagement	4	3	3	Motivation	4	2	3
				Mathematical resources	2	3	1
9.High expectations	3	3	3	Behaviour	5	3	3
				Risk taking	4	3	3
10.Social support	4	4	2	Social organisation	1	3	1
				Teacher/Student relationships	4	4	3
11.Student self-regulation	3	3	2	Student autonomy	3	3	2
12.Student direction	2	3	1	Problem Solving & resources	2	3	2
Total D2	**20**	**17**	**13**		**25**	**24**	**18**
Dimension 3							
13.Background knowledge	2	5	2	Building on prior knowledge	3	4	2
14.Cultural knowledge	1	1	1				
15.Knowledge integration	1	3	1	Integrated lessons	3	3	1
16.Inclusivity	3	4	3				
17.Connectedness	2	3	1				
18.Narrative	1	3	1				
Total D3	**10**	**19**	**9**		**6**	**7**	**3**
Element Total	**52**	**51**	**34**	**Component Total**	**58**	**48**	**35**
Total of element and component scores for each lesson					**110**	**99**	**69**

Table 37 Lesson scores over the two years

Lesson scores over the two years of teaching			
	1st lesson	**2nd lesson**	**3rd lesson**
2002	103	109	122
2003	110	99	69

Remembering that, in choosing to video-tape a lesson, no consideration was given to the content focus of the lesson or special effort made in preparation, the lessons video-taped were not necessarily typical of my teaching or normal lesson structure. This was true of the final lesson in 2003 which was focused on the process of problem solving, a topic with which the students were unfamiliar and at a time of year that was very unsettling, being the second last week of Term 4. I certainly set out to provide interesting problems and let the students work out solutions, trying to control my natural inclination to give them helpful hints, in line with the recommendations of the literature (Chatterley & Peck, 1995). However, my lesson preparation consisted of little more than photocopying the sheets provided by the other Year 4 teacher. Despite being aware that reformed teaching does not fit with the approach that 'anything goes' (Cobb et al., 1991), no lesson preparation had taken place, in terms of thinking through the processes of solving problems and how students might have been supported in this. This was related to the workload, the winding down in all subjects because of the time of the year and most importantly my continued ignorance of what a problem solving approach looks like in a primary classroom. This is an important issue and possible solutions will be suggested in Chapter 8. My experience by this time in the project still consisted of the video-taped lesson I had viewed at university (NSW Department of School Education Western Region, 1989) and my own efforts with my previous Year 2 class and the few attempts I had made with this Year 4. None of these involved the provision of the types of problems provided for these problem solving lessons.

In looking at the previous two video-taped lessons in 2003, it is notable that the scoring of the first lesson, in terms of the elements and components in the Intellectual Quality dimension of the Framework, was a slight improvement on the best lesson at the end of Year 2, although scoring less in both the Quality Environment and Significance dimensions (see Tables 35, 36, pp. 270, 271). The problem solving approach evidenced in this lesson occurred prior to my decision to take a general approach to improve my teaching, due to the pressures of the workload. In my perceptions of the quality of the Number lessons taught in this year, this lesson was very near the best of my efforts. It is regrettable that my efforts did not develop from this pleasing start, but my decision to focus on coming to terms with the content of the Year 4 mathematics curriculum, only making general efforts to improve my teaching, contributed significantly to the lack of development in the quality of my mathematics teaching. This is in contrast to my deliberate and focused efforts to improve my teaching through the use of non-routine problems, investigations and worthwhile discussions in the previous year which yielded positive and encouraging improvements in the quality of my teaching.

The second video-taped lesson was the only Measurement strand lesson recorded in the two years. My efforts to improve my teaching in the first year of teaching, through the introduction of non-routine problems, only included Number lessons. No specific efforts were made to incorporate non-routine problems, in either Measurement or Space lessons, in either year of teaching. Hence, Measurement and Space lessons, in both years, were based mainly in textbook work with the provision of appropriate manipulative resources. Many of these pages were investigative in nature and my greatest difficulty was locating resources that matched the prescribed activities as evidenced in this video-taped lesson. The textbook activities for both of these strands were very time consuming and the provision of alternate problem solving activities, would have been very difficult to accommodate in the limited time available.

Making the vision a reality

Daunting and hard

The most difficult task, in commencing teaching in 2002 with the aim of implementing components of reformed mathematics education, was knowing where to start, particularly when constrained by the mandated use of the textbook which formed the basis of the mathematics program. However, on reflection, if no textbook had been provided my difficulties would have been compounded by the immediate necessity of organising an alternate approach to my program and locating or making appropriate resources to support this approach. Either way, the difficulty would have been knowing where to start in my efforts, a decision that was postponed for a term by the provision of the previous program and the textbook, while I settled in and established classroom routines. As previously explained, my only experience of reformed teaching had been in preservice course tutorials as well as in the pages of mathematics research literature and the picture I had was complex and daunting. In light of the literature my concerns were well grounded. Reformed teaching is more demanding than traditional practice (Brown & Smith, 1997; Wood, Cobb, & Yackel, 1993) and fewer teachers use it effectively (Davis, 1997; Ross, McDougall, Hogaboam-Gray, & LeSage, 2003). Most teachers have not seen this type of teaching in practice (Davis, 1997) and experienced teachers struggle in their efforts to change their practices in line with the recommendations of reform (Heaton, 1994; Heinz, Kinzel, Simon, & Tzur, 1997; LeSage, 2005).

Vision not the problem – practicalities are

Prior to my decision, to implement non-routine problems and investigations as a focus of my teaching, I had been labouring with a vision of teaching I did not know how to bring to life. Anderson and Bobis (2005) wondered if the difficulties teachers encounter, in implementing constructivist teaching approaches, might be due to the lack of a vision of what they look like in practice. However, they found respondents in their study generally seemed to be well aware of the recommendations of the reform-based movement. Certainly this is true in my case. I had a very clear and well informed vision of effective mathematics teaching. I imagine that there would be few beginning teachers with a clearer theoretical understanding of the nature of reformed teaching, as a result of my previous research into the beliefs, attitudes and practices of primary school teachers in mathematics (Forrester, 2000). However, this did not ensure that I could convert this vision into reality. Even with the considerably reduced workload and the lack of work related stress I enjoyed in this first year of teaching, I required support in determining how to approach the task. In the process of speaking to the visiting academic about my frustrations with my efforts in the first term of teaching and the constraints of the textbook, I was able to clarify my thinking. Her suggestion, to introduce non-routine problems in two lessons a week and to complete the textbook work in the other two days, was the prompt I needed to determine a way forward. The follow-up needed to research and locate resource materials to support me in my decision took considerable time and effort.

In my full-time year of teaching, there is no doubt that I would have benefited from the opportunity to talk to more experienced reform-oriented teachers, to assist me in determining a way forward and to support me in reflecting on my practices. However, my needs in this second year were considerably more than they had been in my part-time year of teaching. The provision of more preparation time in the reduction of face-to-face teaching and the associated reduction in stress levels would have supported me and made the possibility of change more likely, although I would also have required assistance in the practicalities of implementing quality teaching practices. Almost total dependence on the mathematics textbook may not be best teaching practice, however, the textbook was one of the few aids to come to my assistance, as opposed to my seeking assistance, in both my years of teaching. It provided a way forward when I had no idea where to start in my first year of teaching and when I had no time or energy to look for or implement alternatives in my second. In Chapter 8 these difficulties are addressed and possible solutions suggested.

Need to funnel efforts

In reflecting on my two years of teaching, the decision to concentrate my efforts on a particular component of reformed pedagogy was an important step in the process of improving my teaching. The individual components of reformed pedagogy as detailed by Clarke (1997; 1999) are complex, requiring a solid knowledge of mathematics and skilled teaching to undertake effectively. As a beginning teacher, a generalised approach to implementing them all was an unwieldy challenge. The decision to introduce non-routine problems and investigations as a focus for my initial efforts at implementing reformed practices, on the advice of a mathematics education academic, made the challenge manageable. Within the confines of my part-time load this approach was quite successful.

Interestingly, my decision, in the second year of teaching, to abandon this process and try to generally implement components of reformed teaching while coming to terms with the Year 4 curriculum, due to the pressures of the workload, saw no improvement, possibly deterioration, in my teaching. It seems that my early efforts in 2003 teaching full-time, in some lessons at least (e.g. Video-taped lesson of 3.4.03), were consistent with those in the previous year teaching part-time. However, in making allowances for my workload at the end of Term 1 2003, I gave myself permission to utilise traditional pedagogy based in explanation, demonstration and practice, using the textbook and supplemented by the use of manipulative materials. While this was not a conscious thought at the time, I suspect my decision to focus only on Year 4 content was giving myself permission to retreat to what was familiar and comfortable in order to cope with a stressful and uncomfortable situation. Notably, my teaching became a reflection of my initial vision of myself as teacher (see Table 34, p. 255), the vision of myself implementing well-known and manageable strategies, teaching as I was taught, with the addition of manipulative materials to scaffold student understanding. Implications of my successes in 2002 and my lack of progress in 2003 are drawn and possible solutions suggested in the next Chapter.

The effects of the study on my practice

In my first year of teaching, despite having ample time for planning, a clear vision of reformed teaching and the motivation of this research to encourage my efforts, my inexperience, lack of support from a more experienced advocate of these methods and the need to research and locate appropriate resources without guidance, made it difficult to be sure of the way forward. My school colleagues were happily and confidently teaching in ways acceptable to the school community, achieving results that were considered appropriate, using the textbook as their basis. Under normal conditions, without the motivation of this study, my intention of trying to implement reformed practice may well have seemed too hard and either abandoned before it began or postponed until I felt more comfortable with the development of my skills and confidence. This is virtually what happened in the second year of teaching with the added pressures of the full-time workload and associated stresses. I wonder, with the pressures of full-time teaching, if the time might ever have been right, without considerable support and encouragement from my school community, to move towards reformed teaching practices.

The benefits of introducing non-routine problems

The decision to focus on the introduction of non-routine problems as the basis of Number lessons and to introduce number fact investigations saw an improvement in students' identification and explanation of mathematical patterns, computational strategies and the processes involved in their solution attempts. However, it also had a roll-on effect in scaffolding the development of reformed practices in several areas of my teaching. These developments did not approximate the sophistication and success described in studies of experienced teachers' efforts at implementing reform such as the Purdue Project (Cobb et al., 1991; Cobb et al., 1993; Wood, 1993a, 1993b; Yackel, Cobb, & Wood, 1993a; Yackel et al., 1993b), the CGI program (Fennema et al., 1996; Fennema et al., 1989), Lampert's work using her own teaching as a site for research (1986; 1988; 1990), or Heaton's research on her efforts as an experienced teacher to align her practice to reform documents (1994; 1995). However, it is relevant to note that the introduction of a problem solving focus to Number lessons had a roll-on effect in other areas, including:

- Some change in the emphasis of my lessons from the reproduction of content knowledge, skills and procedures to the processes of mathematical thinking, encouraged by the NSW Department of Education and Training recommendations for quality teaching (2003a), the mathematics Syllabus (Board of Studies NSW, 2002) as well as the mathematics education literature (Bauersfeld, 1992; Boaler, 1993; Booker, 1999; Perso, 2001).
- Some improvement in class discussions where students began to share their thinking as well as their answers, a start in my efforts to establish a mathematics discourse community as described in the literature on reform

(Booker, 1999; Carroll, 1997; Chapin & Eastman, 1996; Clarke, 1997; Cobb et al., 1993; Frid & Malone, 1995; Groves & Doig, 2004; Hicks, 1998; Perso, 2001; Schoenfeld et al., 2000; Wood et al., 2006).

- Some reduction in the emphasis on right or wrong answers as advocated in the mathematics education literature (Blunk, 1998; Booker, 1999; Heaton, 1994, 1995; Heirdsfield, 2005; Lampert, 1990; Roh, 2003; Stipek et al., 1998; Whitin, 2004).
- The establishment of class norms for behaviour, instituted to support problem solving activities and investigations, which although a struggle to maintain, also helped support the establishment of more constructive group work (Blunk, 1998; Yackel et al., 1993b) and better discussions (Cobb et al., 1991; Groves & Doig, 2004; Johanning & Keusch, 2004; Philipp et al., 1994; Steele, Winter, 1999/2000; Wood, 1993a).

These improvements saw the development of a classroom culture considerably closer to that advocated in the literature. Students expected to share their answers with the class (Carpenter et al., 2001; Philipp et al., 1994; Simon, 1993b), were increasingly aware that their thinking was valued over a right or wrong answer (Booker, 1999; Cobb et al., 1991; Gill & Thompson, 1995; Groves & Doig, 2004), came to realise that mathematics problems can have more than one solution (Booker, 1999; Roh, 2003), that mathematics involves looking for patterns (Heaton, 1994, 1995) and is a sense making activity (Booker, 1999). In Chapter 8 conclusions are drawn regarding this success and implications for preservice and inservice teacher education are suggested.

Focus on improving discussion and assessment

My subsequent efforts to implement other components of best practice in Terms 3 and 4 of 2002 did not have the impact on my teaching that the introduction of non-routine problems had in Term 2 and continued to have in Terms 3 and 4 of 2002. While improvements were obvious in both class discussions and my efficiency in assessing for reporting, the very complex nature of these components required sustained development over time in order to make substantial progress.

The complicated nature of developing worthwhile classroom discussion is evident in the work of Wood, Williams and McNeal (2006), who found that considerable differences exist in reform-oriented classes, in terms of the quality of students' thinking as evidenced in classroom interactions and discussions. They categorised two major types of classroom discussions as 'strategy reporting' and 'inquiry/argument' and explained that they typify the cultures of different reform-oriented classrooms. Students in classrooms that use the 'strategy reporting' type of discussion are asked to present their solutions and may be asked *how* they solved the problem by the teacher, but rarely by other students. Children in 'inquiry/argument' classrooms offer different solutions methods and are asked *how* and *why* they used those strategies, by both the teacher and other students, often resulting in challenges or disagreements which prompt further justification of students' ideas. Students benefit more from classrooms that foster discussions requiring greater involvement, in terms of higher levels of expressed mathematical thinking. In considering the discussions in my classroom, at their best they were typified by 'strategy/reporting' characteristics.

Although informal assessment to inform instruction is a component of reformed teaching as described by Clarke (1997; 1999), in beginning the first year of teaching I did not have it as one of my goals. While I was looking to focus on student thinking I had an underlying belief that it would be too difficult to structure my teaching on students' needs, as I assessed them, at this stage of teaching and that I needed to focus on improving other skills before focusing on this. I nevertheless had it in the back of my mind when I commenced teaching in 2002.

It did in fact prove difficult to focus on student thinking and this remained a problem throughout the two years of teaching, especially in the course of lessons, because of the number of other things occupying my mind in the moment-by-moment operations of the lesson. This was not to say that I was unaware of any student thinking. Over the period of the two years I was aware of some problems particular students were having with specific mathematical content, identifying students that seemed more likely to experience difficulties and ensuring they were monitored and supported where necessary. I also became increasing aware of types of errors that appeared to commonly and repeatedly occur with groups of children, building on the taxonomy of errors types described by Berliner (1988) that is the basis of a “diagnostic-prescriptive form of teaching” (p. 53), and trying to address them in my teaching, with mixed success.

My greatest difficulty was deliberately focusing on student thinking, especially with the intention of making records of progress, for my own planning and for the purposes of formal assessment. Desforges and Cockburn (1987) argued that diagnostic assessment is an “excruciatingly difficult” task under ideal circumstances (p. 14). The complexities of the day-to-day teaching situation are enormous and the “bombardment of information and an incessant demand for decisions” (p. 104) can stretch any teacher, not just a novice, to her limits. They maintained that in novel situations humans cannot successfully process very much information at once. This was certainly my experience, and despite focusing my attention on the task in Term 4 of the first year of teaching, assessing for reporting required skills I was still developing. I concluded “I don’t know how to do it as part of the regular routine...I think this one is a very long journey” (Program Y2 T4 2002, 238).

Things that were constant

Over the course of the two years of teaching, two factors remained fairly constant in their importance across both grades and were not greatly affected by the part-time or full-time workloads. The first factor was the use of concrete materials to scaffold learning, the second, the difficulties I had in covering the required mathematics program within the time allowed in the mathematics program.

Mathematics resources

My original vision of self-as-teacher (Table 34, p. 255) included me, as teacher, supplementing the use of traditional teaching methodologies with the provision of manipulative materials to support students in their mathematical understandings. The provision of appropriate mathematics resources was a priority before the commencement of teaching and continued as a priority throughout the two years of teaching. In my first year of teaching their importance is evidenced in my decision to program and plan around their availability, locating them days in advance in order to avoid having to teach without them or teach alternate lessons. Due to workload, I was unable to do this in the second year, but their unavailability would lead me to teach another lesson, at short notice, rather than teach without them. In the first year of teaching they were made available in every lesson, in the second, for all except a handful of lessons where they were not considered necessary.

It would be fair to say that the materials provided to students for different lessons were always provided to scaffold student understanding, but would fall within various categories of manipulative usage including the provision of ‘hands-on’ experience, modelling concepts, scaffolding the introduction and development of written forms of mathematics, playing games and to support investigations and to solve routine and non-routine problems. Their use would fit within Nickson’s (2004) summation of the commonly accepted notion that the physical manipulation of concrete materials helps children learn mathematics in more meaningful ways, originating in the importance placed on the Piagetian stages of the development of children’s thinking (Lefrancois, 2006). There were times in my lessons that their use could have been described as superficial, in line with the findings of other research (Knapp & Peterson, 1995; Smith III, 1996).

I was aware of mathematics education literature warning that the use of manipulative materials does not ensure students learn the intended mathematical concepts (Clements, 1999; Perry et al., 1999) and became aware of some of the frustrations that can be associated with depending on their use to clarify student understanding. Both examples were related to the use of MAB materials: firstly, some students could not make the connection between manipulating the blocks to solve a problem using trading and using trading marks in the formal algorithm; secondly, being familiar with using a flat to represent a hundred, when it was used to represent a unit in decimal fractions, several students found it confusing and continued to struggle with it for the remainder of the year. This is in line with the work of Gravemeijer (cited in Nickson, 2004) who warned that the tangibility of concrete materials does not equate with making mathematical sense of the objects. Ball (cited in Marshall & Swan, 2005) warned that as adults we can often overstate the power of a concrete representation because we already understand the mathematical concept and how it is represented in the manipulative material, whereas children, who do not have the same mathematical understanding may reasonably see something quite different.

Time constraints

As distinct from workload, the time constraints of the mathematics program were a difficulty over the two years of the study, one which I never completely overcame, continuing to struggle to cover the work required in the time allotted. This was not only a problem in mathematics, with all KLAs being affected by interruptions to the normal routine, often resulting in changes to the program. However, mathematics was the subject that was most difficult to cover in the time allotted. This was a problem in the well planned lessons in my first year of teaching, where I came in early to set up and stayed back to clean up and mark work, avoiding the need to involve the children in these activities. It was also a problem in the inadequately planned lessons in the second year of teaching that often involved students in organisational tasks and marking.

In the book *What's your problem?* Skinner (1990) described her problem solving approach to mathematics with a class she taught for two and a half years throughout Kindergarten, Years 1 and 2, taking up the time between recess and lunch time everyday, considerably more time available for mathematics than either my Year 2 or Year 4 mathematics classes. Currently, the recommendation in NSW schools is that approximately 20% of school hours be spent on mathematics in the primary years (Board of Studies NSW, 2005) which is equivalent to approximately five hours in a typical teaching week. At four hours and thirty five minutes a week, the hours allocated at the school in which I taught were short of this, but within the current parameters issued by the Board (45-55% of time to be spent on literacy and numeracy) (Board of Studies NSW, 2005). There is no doubt that the hours taught were also within the parameters existing at the time of teaching, as this school complied with Board of Studies registration requirements.

Instruction based on constructivist principles takes longer than alternate methods (Goldin, 1990; Simon, 1989), and the pressure of time is a common difficulty encountered when trying to implement reformed teaching practices (Simon, 1989; Tobin & Imwold, 1993). However, I experienced this difficulty, regardless of whether I was implementing teaching methodologies associated with reform or more traditional methodologies and presume that my inexperience was largely responsible.

Confidence in my teaching

There is a considerable contrast between my preparedness to teach in 2002 and 2003. In the first year I was well organised because there was comparatively little to organise. I had familiarised myself with the teaching space, the mathematics resource storage area and the compulsory textbooks. I was confident in my knowledge of the lesson content that was detailed in the first weeks of the program, I had made plans for behaviour management routines and classroom organisation. While, in commencing to teach in 2002, I was not confident in my ability to implement elements of best practice in mathematics, I felt confident that I would cover the required content, provide engaging activities and any problems experienced would not be the result of poor preparation. When I commenced my second year of teaching I was feeling that there was much that was out of my control. Having to prepare for the full range of KLAs, with no experience of any at the Year 4 level, was very daunting. Having no personal resources and very limited mobility made the task more overwhelming and never having set up a classroom, I did not know what I needed. My preservice course, professional experience placements and RFF teaching provided no preparation for this; this was discovery learning under pressure.

My first and main concern was behaviour management, and the perceptions I had of myself, and I believed others had of me as a competent teacher, were very much related to behaviour management and classroom control. However, my confidence in myself as a teacher also related to other aspects of my teaching, including my knowledge of content and pedagogy, my experience in all aspects of teaching and my efforts to implement elements of reformed pedagogy. It should be noted that the level of my self confidence was not constant, nor did it gradually increase over the two years. It was very much related to the day-by-day events in the classroom. It fluctuated with my positive or negative perceptions of interactions with students, staff and parents and was affected by personal factors, outside of school, which influenced my emotional responses to the challenges, successes, failures and frustrations experienced from day to day.

Onafowora (2005) maintains that the feelings of not being a good teacher are common to novices, but the development of teachers' self confidence is essential to the development of teachers' self efficacy, a characteristic associated with the attributes of quality teachers. Teachers' self-efficacy refers to their beliefs that that they have the "self-judgments and capabilities to create and organize instruction that motivate student learning" (p. 36), the emphasis being on teachers' beliefs and judgments rather than their skills. It affects the types of learning environments teachers create and the academic progress of their students. It is related to confidence in themselves; that their efforts to teach in difficult circumstances will be successful and not dictated by factors outside of their control.

Novice teachers appear to develop their “knowledge, affective, and psychomotor abilities and skills” (Onafowora, 2005, p. 35) unevenly and while they may know what to do, they lack the pedagogical experiences and affective abilities to utilise this knowledge effectively (Onafowora, 2005). Experience is obviously vital in building these skills and abilities, although reflective teaching practices also build confidence, autonomy and self-efficacy (Lowery, 2003). However, having the time and energy needed for reflection are problems for the novice (Sparrow & Frid, 2002) and the need to be reflective yet another challenge. In Sparrow and Frid’s (2002) research regarding the effectiveness of a fellow-worker professional development model, novice teachers were prompted to reflect on their teaching, in the light of their preservice knowledge of children’s learning and effective mathematics education, by meeting with the fellow-worker. This process assisted these novice teachers to improve their teaching in line with best practice, implementing changes in their pedagogy based on their reflections. In undertaking my study, diarising was necessary for data collection and, therefore, the need to reflect was enforced by the research. However, the quality of these reflections changed from the first year to the second. Whereas, my reflections in the first year of teaching were largely concerned with my efforts at implementing best practice, in my second year they involved my efforts to survive. They detail the workload, stress and pressures of full-time teaching and the resultant, largely traditional, efforts in my mathematics pedagogy. Without the external constraint imposed by this study, I am nearly sure that in that second year, teaching full-time, I would not have kept a diary and would, therefore, not have taken the time to consider my teaching in any depth.

Inexperience and confidence

In my first year of teaching part-time my inexperience surfaced in my understanding of mathematics content and pedagogy, whereas in teaching full-time it also impacted my teaching in more basic ways. Many tasks were more complicated and time consuming than necessary, because I had never done them before. Tasks ranging from the organisation of medication for the school camp to the organisation of a list of appropriate comments for reports, writing letters to request parent assistance with reading groups to learning how to keep a class roll. Being a mature aged, inexperienced teacher I had the advantage of being perceived by parents as more experienced, but the disadvantage of that presumption as well. No leeway for inexperience could be expected from parents asking a question I could not answer in a parent/teacher interview. Being mature aged I suspect also affected the amount of support and advice I received from my supervisors, either presuming I did not need it or would be affronted by the offer, possibly feeling uncomfortable knowing I was studying for a PhD. Bullough and Knowles (1990) maintained that this is not unusual, noting a "tendency to withhold assistance from older, more mature beginning teachers, believing they do not need or want it" (p. 110).

As already discussed my inexperience across all KLAs caused difficulties and, as one would expect, affected confidence in my teaching. In mathematics this inexperience related to my lack of knowledge in several areas which caused the following difficulties:

1. My inadequate *knowledge of student thinking* led me to:
    - Teach content that was too difficult for my students (Video-notes 1.5.02; Program Y2 T2 2002, 54).
    - Teach content that appeared so easy that I wondered if I had missed the point (Program Y2 T2 2002, 299-300).
2. Shortcomings in my *mathematical content knowledge* were evidenced in:
    a. My limited knowledge of the Syllabus (NSW Department of School Education, 1989), leading me to:
        - Teach content that was too difficult for my students (Video-notes 1.5.02; Program Y2 T2 2002, 54).
        - Miss the main point of a unit from the Syllabus in my lesson (Diary Y2 T2 2002, 43).

    b. The inadequate depth of my mathematical content knowledge led me to:

- Teach concepts inadequately (Program Y2 T4 2002, 63; Diary Y2 T4 2002, 8, 19; Diary Y4 T4 2003, 49).

3. My underdeveloped *pedagogical and pedagogical content knowledge* led me to:
    - Struggle when teaching algorithms to help students who were having difficulties in grasping even a procedural understanding of trading and the commonly accepted algorithms (Program Y4 T3 2003, 311-316; Diary Y4 T3 2003, 292-306).
    - Have difficulties overcoming student struggles in understanding mathematical concepts (Diary Y4 T4 2003, 226-230; Program Y4 T4 2003, 126).

Knowledge of students, content knowledge and knowledge of pedagogy are among the types of knowledge identified in Mewborn's (2000) study and critique of the empirical research on Kindergarten to Year 8 teachers' knowledge, as essential to effective primary school teaching. The complexities of these require much more than a theoretical understanding and are developed through experience and reflection (Berliner, 1988; Lowery, 2003).

Confidence to try best practice

Insecurity about teaching practice is typical of beginning teachers in their first years of practice, constantly questioning their practice and needing encouragement and support (Worthy, 2005). Fottland (2004) characterised herself as a 'fledgling' teacher to capture the insecurity associated with her first years of teaching. It is little wonder that in this period of insecurity that, as some studies have found, beginning teachers' "actions and attitudes change in the direction of the actions and attitudes of currently practicing teachers" (Brown & Borko, 1992, p. 223) and that the effects of teacher education are diminished due, in part, to the more powerful effects of school culture (Gore, Cooper, & Williams, 2003).

My efforts to implement elements of best practice saw me vacillate between frustration, disappointment, satisfaction and exuberance throughout the first year of teaching. My experience of teaching mathematics part-time was undertaken in isolation, only making contact with other teachers outside of lesson times and in these times my efforts to implement best practice were never discussed. I had no encouragement or support for these endeavours, except the intrinsic rewards that came from seeing some success. Feedback from my Stage supervisor on the lesson she observed was positive, but I took no risks in terms of showcasing my efforts to implement reformed pedagogy through the provision of non-routine problems. I taught an engaging infants lesson, utilising group work and focusing on providing hands-on experiences to support learning and I worked hard at maintaining good class control throughout. This might be likened to 'playing a game', an approach I took to my professional experience placements as well as to my supervisors' appraisals throughout these two years, teaching in ways that will please those that need to be pleased in the process of being assessed. Rorrison (2005; 2006) likens this to 'jumping through hoops', aiming to maintain the status quo, without the confidence and experience with the non-traditional pedagogies introduced at university to be able to challenge the established structure or roles within a school context (Rorrison, 2005). Unlike the students in Zevenbergen's (2005) study of preservice teachers, I did not let my experiences in schools override my preservice course experiences, in rejecting the methodologies promoted in these courses. I chose to avoid difficulties in my assessments knowing that my cooperating teachers on professional experience placements, and supervisors in the schools in which I have taught, did not hold similar views on pedagogy.

At the end of both years of teaching I rated myself against the elements of best practice in mathematics teaching (see Table 38, p. 290). My ratings were simply instinctive responses based on my experiences in the year, a ranking of 10 being my ideal. I did not refer to the previous year in my assessment of the my second year of teaching, in terms of my rankings, and it is interesting to note the differences as perceived at the time and reflect upon them several years further into my teaching career.

Table 38 Summary of the ratings of my practice in 2002 and 2003

Summary of the-ratings of my practice in 2002 and 2003		
Element of best practice of early-career teacher	**2002**	**2003**
1. Useful behaviour management skills using both positive and negative reinforcement, but focusing on the positive	9	9
2. A safe risk taking environment where children feel safe to share their answers and thinking	8	9
3. My understanding of the mathematics content for each year	9	7
4. My understanding of the possible ways children will approach different aspects of mathematics and their mathematical thinking in these years	6	4
5. A problem solving approach to enable children to ‘discover’ the mathematics	6	3
6. A culture of “talking about doing mathematics”	6	4
7. A culture of participating cooperatively in a group to solve problems and present your solutions to others	6	3
8. A culture where mathematics is not about getting ‘right’ answers but about the process of getting an answer	6	6

It is notable that I was very confident in my behaviour management skills and the provision of a safe environment for my students, at the end of both years of teaching (Elements 1 and 2). This is despite the difficulties I had with one child in the second year of teaching, who would not share his ideas or thinking and whose behaviour was a challenge. In reflecting on my rankings in the second year of teaching, it is difficult to know whether this is a self-protecting measure where I ignored these difficulties, in terms of them being my problem or associated with shortcomings in my personality or teaching skills, or whether I was ranking my skills in terms of what I considered normal behaviour management difficulties, as I considered this child’s behaviour as outside my normal experience and could not find help in how to deal with it in behaviour management support literature. While the analysis of the difficulties in terms of Brousseau’s (1984) didactical contract has brought some clarity to the relationship, there is still a considerable degree of anxiety surrounding these events and even the passing of time has not allowed me to view this objectively.

Despite deciding not to focus on introducing elements of best practice in the second year of teaching and simply to come to terms with the Year 4 content, I felt less confident in this knowledge than I was of the Year 2 content at the end of the first year of teaching (Element 3). This was substantially related to the workload in the second year of teaching, where I felt that my ability to focus on a range of educational issues had suffered, but also on the more complicated nature of the Year 4 content and the necessity to come to terms with algorithms that were outside my own educational experiences.

In reflecting on the rankings of Elements 4-8, I would challenge my initial ranking, at the end of 2003, of my efforts to provide a problem solving approach to mathematics (Element 5). There were very few lessons involving non-routine problems provided in Number in 2003 and the investigatory lessons in Measurement and Space did not provide for a problem solving approach either. I would also contest the ranking of my efforts to develop a culture where right answers were not the focus of mathematics lessons (Element 8) in the second year of teaching. While I certainly endeavoured to support this notion in our lessons, the textbook focused approach to teaching undermined this message and it was considerably less evident as part of our class culture in the second year of teaching than it had been in the first.

Resilience

In researching the literature on the significance of beginning teachers' confidence, the importance of teacher resilience has emerged as a vital characteristic of beginning teachers who survive the first years of teaching, as well as in the effectiveness of experienced teachers (Bobek, 2002; Tait, 2005). "Resilience is the human capacity to face, overcome and even be strengthened by experiences of adversity. It is the ability to 'bounce back' after a setback. It is also the capacity to see things realistically and to recognize what is possible and what is not. Resilient adults are able to maintain positive relationships, solve problems skilfully, set limits, stay motivated and derive some sense of meaning from difficulties and challenges. They confront failure with optimism and persist in the face of difficulty" (Tait, 2005, p. 12).

Resilience can involve personal characteristics such as problem solving skills and prior experience (Bobek, 2002) and is fostered by positive, supportive relationships with colleagues, family and friends (Bobek, 2002; Tait, 2005). It is related to teachers' self confidence and their perceptions of themselves as competent (Bobek, 2002; Tait, 2005) and is critical in successful teaching and retaining teachers in the profession (Bobek, 2002). "Feeling effective as a teacher is at the heart of resilience, and new teachers need reasonable and appropriate teaching assignments in which they feel competent" (Tait, 2005, p. 13).

At the commencement of my first year of teaching, I lacked the experience to approach the implementation of components of best practice with confidence. However, once I experienced some success with my initial efforts to introduce non-routine problems and investigations, my feelings of accomplishment contributed to feelings of increasing competence and self-confidence as a teacher of mathematics. However, these efforts were not undertaken within the normal context of a classroom teacher, where the pressures of full-time teaching provide complex difficulties and challenges across all aspects of teaching. In contrast, my second year of teaching full-time across all KLAs saw me struggle with feelings of incompetence and fluctuating self confidence. While I endured, with the support and encouragement of my family and the friendship of my Stage colleagues, it was with survival responses rather than resilience. By Term 3 I struggled to maintain motivation for anything other than meeting the next deadline. My relationship with and commitment to the children ensured that I continued to put as much as I could into providing engaging lessons, with the additional benefit from the perspective of my own survival needs, of avoiding behaviour management difficulties as a result of student boredom.

In terms of Tait's (2005) stipulation that beginning teachers should be given reasonable and appropriate teaching assignments if they are to experience success, build feelings of competence and develop resilience, I certainly had the formal qualifications to undertake this position. However, with no allowances made for inexperience and the lack of on-the-job support, this regular classroom teaching position was experienced as relentless and unreasonable in its demands, diminishing feelings of competence and undermining my resilience.

Summary

This discussion has explored the issues that emerged from the data collected over the two years of teaching. It examined my goals when commencing this study, my ideal vision of self-as-teacher, which had formed as a result of my preservice studies in mathematics education. It compared this image with my original vision of myself as a teacher of mathematics which encompassed the traditional explanation, demonstration and practice methodologies of my own mathematics education, supplemented by the use of manipulative materials to scaffold student learning.

This chapter has highlighted the striking differences between my experiences as a part-time teacher in my first year of teaching and my second year as a full-time classroom teacher. The effects of the differing workloads have been shown to have had a considerable impact on my efforts to implement best teaching practice in mathematics. Whereas the first concern I had in both years of teaching was the establishment of effective behaviour management routines, the major constraints on my efforts to implement elements of best teaching practice differed markedly in the different contexts. The textbook, considered an impediment to my efforts in my first year, became a 'life saver' under the burden of the relentless workload in the second. Interestingly, due to the impact of the workload, my teaching throughout the second year of the study, in many ways, mirrored my original vision of self-as-teacher, using largely traditional teaching methodologies accompanied by the use of manipulative materials.

While the study was not designed to quantify student learning as a measure of the effectiveness of my teaching, it became evident that the workload in the second year of teaching inhibited my development as an effective teacher of mathematics. Even within the relatively easy context of teaching part-time, my desire to implement elements of best practice did not easily translate into a clear plan of action. Practical support was needed in deciding where to start and would have been beneficial throughout the project.

Two factors remained reasonably constant over the two years, the importance I gave to the provision of mathematical resources and the difficulties I had teaching the content of the mathematics curriculum within the limitations of the time allotted. No major issues impacted my teaching in the first year of the study, although difficulties in my relationship with one student and the continuing health concerns of my daughter affected my ability to cope with the stresses and pressures of my second year of teaching and undermined my confidence in myself as a teacher. The problems experienced were compounded by lack of advice and support from my supervisors and the absence of an experienced mentoring associate or colleague. While I survived this very difficult year, with the support of my family, in particular, and the friendship of the other teachers on Stage 2, I emerged feeling battered, exhausted and considerably less resilient than I had felt at the beginning of the study. Subsequent, successful part-time teaching assignments have seen increases in self confidence, the recovery of resilience, the restoration of motivation and the desire to persist rather than the need to endure.

A general desire to implement reformed teaching practice, in its entirety, was not an effective approach in improving my teaching, as seen in the second year of teaching. Concentrating on implementing one component, namely the introduction of non-routine problems as a focus for mathematics lessons, however, saw progress across a range of components of effective mathematics teaching. Improvements were seen in group work, classroom discussions and the development of a classroom culture which valued mathematical thinking over correct answers. While focusing, subsequently, on improving discussions and assessment also saw improvements, the implementation of a problem solving and investigational approach saw the greatest changes in my classroom practices and the culture of mathematics lessons.

CHAPTER EIGHT

Conclusions and Implications

Introduction

Chapters 5 and 6 analysed the data pertaining to my efforts to implement components of effective mathematics teaching in my first year teaching mathematics only on a part-time basis and my second year of teaching full-time as a classroom teacher. Chapter 7 discussed the development of my teaching over the two years, exploring the issues of importance as they arose from the data and contrasting my efforts in the first and second years of teaching. This chapter uses this discussion to draw conclusions and implications. It outlines the limitations of the study and concludes with recommendations for further study.

Summary of the study

This thesis describes the findings of a qualitative self-study into the lived experiences of a beginning teacher of primary school mathematics, in my efforts to implement components of effective mathematics teaching, based on current research, in the light of recommendations for quality teaching as detailed in the NSW model of pedagogy (NSW Department of Education and Training, 2003e).

From the available literature on quality teaching and effective mathematics education, components of quality mathematics teaching were identified. Research into the process of becoming a teacher including: the influential factors in this process; the developmental stages of learning to teach; the issues and problems commonly experienced by beginning teachers; and the difficulties experienced by both veteran and beginning teachers in trying to translate constructivist learning theories into good teaching practice have been examined. It was established that first-person inquiry as a method of researching the lived experience of teaching has provided valuable insights into the process of teaching. While this type of research has been utilised to examine the experiences of practised teachers in their efforts to implement reformed mathematics teaching (Ball, 1993b, 2000; Chazan, 1992; Heaton, 1994, 1995, 2000; Lampert, 1986, 1990, 1995, 2000; Simon & Tzur, 1999), the experiences of beginning teachers have not been investigated from this perspective. This self-study inquiry was undertaken in an effort to offer insights into the challenges of trying to teach mathematics in ways consistent with the current mathematics research literature as a beginning teacher and to give insights into what it is *like* to attempt this as a beginning teacher.

In 2002 I commenced teaching mathematics with a Year 2 class, one hour a day, four days a week. With the exception of a mathematics mentals textbook page completed with the students' classroom teachers, I was completely responsible for the mathematics program for the students in my class. My responsibilities included programming, planning, assessing and reporting on the progress of my students. At the end of 2002, I sought and was offered a full-time position for the last four weeks of 2002 and the entirety of 2003. For the last four weeks of 2002 I was the home class teacher for a Year 2 class that consisted of some students I had taught all year and others that I had not taught at all. In 2003 I undertook the position of a Year 4 classroom teacher responsible for teaching mathematics and English to streamed Year 4 classes and the remaining KLAs to my home class, with the exceptions of art and music which were taught by specialist teachers in the RFF teaching time.

Data were collected over this two year period in the form of teaching diaries, programs, video-taped lessons and associated notes. Data from the teaching diaries, programs and notes on the video-taped lessons were analysed using the NVivo 2 (QSR, 2002) software package. Video-taped lessons were analysed using the coding scale overview of the NSW model of pedagogy (NSW Department of Education and Training, 2003e) (Tables 7, 8, 9, pp. 115-117) and a set of coding guidelines developed to analyse the components of effective mathematics teaching as identified in the mathematics education literature (Tables 10, 11, 12, pp. 118-122).

Conclusions

The contrast between my experiences in trying to implement pedagogy consistent with mathematics education reform in my first part-time year of teaching only mathematics and the second year of teaching full-time, as a classroom teacher, was striking. It was never the original intention of this research to set up disparate contexts for teaching, in terms of a part-time and full-time workload, over the two years. The focus of the research was on the implementation of reform-oriented teaching practices in mathematics and the first year of teaching was organised to investigate a beginning teacher's experiences doing this. However, in the course of my conversations with other beginning teachers throughout this year of teaching, it became evident that my experiences, teaching only mathematics and teaching part-time, were very different from their experiences as full-time classroom teachers. Therefore, it was felt that a more realistic perception of the experiences of a beginning teacher trying to implement reform-oriented pedagogy required that I undertake a full-time classroom teaching position.

This disparity, however, provided an opportunity to differentiate to some extent between those issues and challenges that arose from the unfamiliar nature of reform-oriented teaching and those that resulted from the unfamiliar nature of beginning to teach.

Research question

What are the influences, issues and challenges a beginning teacher experiences in trying to teach mathematics for understanding, informed by current research and pedagogy?

The influences, issues and challenges to emerge from my experience of trying to teach mathematics for understanding, utilising reform-oriented pedagogy, as a beginning teacher arise from:

- the impact of the workload as a full-time teacher;

- the use of the textbook which was viewed quite differently in the part-time and full-time years of teaching;
- the limited nature of the support received;
- the absence of a clear way forward in planning for change; and
- the need to make a concerted and deliberate effort to change specific aspects of teaching in order to make any notable improvements in reform-oriented practices.

The impact of the workload

For myself, as a beginning teacher, the most notable challenge faced in the two years of teaching was the overwhelming and relentless workload, which impacted with the commencement of the full-time position undertaken in my second year of teaching. The pressures of workload have been well documented as a major concern of beginning teachers (Anderson et al., 2000; Brown & Borko, 1992; McCormack & Thomas, 2003; O'Brien & Goddard, 2006; Rossmanith, 2006) with growing concerns for the effects of workload on all teachers (Gardner & Williamson, 2006; Naylor, 2001). It must be noted that its impact was not in isolation of the other challenges and stresses of that year. However, the heavy workload intensified the difficulties presented by all the other issues, including inexperience with content and pedagogy, behaviour management, family concerns and self-confidence, influencing the quality of my teaching and undermining my resilience.

Effective teachers, among other things, are well prepared and organised (Stronge, 2002). Teachers as professionals are disciplined, adhere to ethical standards and exercise their specialised knowledge of teaching and learning for the benefit of their students (Masters, 2003). Prior to this full-time teaching year, my experiences of teaching had always been associated with feelings of effectiveness, in terms of my preparedness and organisation, and a notion of myself as a professional. I had always been well-prepared in terms of content knowledge, lesson planning, provision of resources to support student learning, providing learning activities that would actively engage my students in their learning and utilising a variety of teaching strategies to provide the best quality of education of which I was capable, in consideration of my knowledge and experience. However, in this full-time year of teaching I struggled to consistently maintain a professional approach to teaching by; always being well-prepared; consistently providing worthwhile active learning experiences in all KLAs; and providing a learning environment that supported the development of higher order thinking through high quality social learning experiences. There was never a time, throughout this year, that there was nothing to do, when everything was completed and up to date. This continuous state of dissatisfaction with my efforts to be prepared and organised was frustrating and demoralising.

Burn-out has been described as a work related syndrome resulting from the perception of a significant gap between expectations of successful professional performance and a far less satisfying reality (Friedman, 2000). It is defined by three characteristics: “the depersonalization of students, feelings of reduced personal accomplishment, and emotional exhaustion” (Maslach & Jackson cited in van Dick & Wagner, 2001, p. 252). School teaching is particularly stressful with at least one third of the teachers considered to be suffering under extreme stress and/or burnout (van Dick & Wagner, 2001). It is evident in the data collected in 2003 that I was experiencing extreme stress and the possibility of burn-out was very real.

The need to survive saw conscious and sub-conscious strategies employed to protect myself. Consciously, these included taking sick leave for exhaustion and stress and putting off school work when it was not absolutely essential to meet a deadline or survive the next day in the classroom. My conscious efforts also involved ensuring that the work provided to my class would keep the children interested and busy, to avoid the emotional drain caused by trying to deal with more behaviour management issues. Unfortunately, this did not ensure that these were always high quality educational activities; there simply was not enough time or energy to be sure of this. I also gave myself permission not to focus on implementing specific changes in my mathematics teaching, but to come to terms with the Year 4 curriculum, a move which saw me, subconsciously, retreat to my original vision of self-as-teacher. Schuck (1996) noted that preservice teachers often reject the new role presented in their mathematics methods courses, in favour of the familiar image of self-as-teacher developed in their own schooling. However, in terms of my reversion to traditional methodologies supplemented by the use of manipulative materials, my behaviour was not a rejection of the new role I had seen in my preservice course. In the circumstances of inexperience and extreme pressure, providing traditional mathematics lessons, supplemented by the use of manipulative materials, was to take refuge in the familiar in an effort to survive.

Interestingly, prior experience as a part-time teacher, which saw me gain confidence in a variety of teaching skills including behaviour management, classroom organisation, programming and planning, seemed to do little in lessening the impact of the full-time workload. I had encountered the need for similar working hours in professional experience placements and while these were intense, they were manageable because they were confined to one month periods. It was the intensity and relentlessness of the workload that became the source of prolonged stress, resulting in emotional and physical fatigue. Tattersall and Farmer (1995) describe work overload as being both quantitative (too much) and qualitative (too difficult) for an individual. As a beginning teacher it was the combination of both that caused excessive stress.

The workload of face-to-face teaching is intense, involves hundreds of interactions each day and requires “a great deal of physical and emotional energy” (Schools Council, 1990, p. 46). Meal breaks are often brief, interrupted by playground duties, student issues, the need to prepare for the next session, mark books or complete administrative tasks. However, face-to-face teaching often involved less than half of the hours I worked in a week, a situation not uncommon in teaching (Naylor, 2001). The fatigue felt after a tough day had to be constantly worked through, adding to feelings of exhaustion and despondency. The job became an inescapable, all consuming responsibility.

The use of the textbook

The mandated use of the textbook emerged as an issue of some importance in both years of this study, providing a challenge to and an influence on my teaching. In my first year of teaching it provided a basis of my lessons when I did not know where to start, in my efforts to make changes in my teaching in line with reform recommendations. It was also a hindrance in taking up time I felt would have been better spent on problem solving activities and restricted the provision of written activities that would have required students to record their thinking as well as their answers. The textbook also made it difficult to move the mathematics classroom culture away from the idea that mathematics is only about getting right answers and towards the notion that the process of finding a solution is as important as the product.

In the second year of teaching the textbook became a crutch at a time when no other support was available. It provided content appropriate written work that was linked to the Syllabus (NSW Department of School Education, 1989), it could be supplemented by other activities (many of which were outlined in the previous program) and/or by the provision of manipulative materials, with little added preparation. This caused an occasional difficulty (for example, when I did not understand the intention of a lesson, such as the use of geo-strips to form triangles which improved the strength of a 3D figure) when I was caught unawares due to inadequate preparation time. However, on the whole the textbook provided lessons that were on par with those being taught in the classes around me and while not ideal, they seemed the best I could do in the circumstances. There is no doubt that in this second year of the study my teaching reflected the findings of research which links the use of textbooks to a traditional transmission model of mathematics teaching (Alsup, 2003; Boaler, 1998). While I endeavoured to focus our lessons on the thinking processes involved in coming to a solution, the textbook undermined these efforts by: only providing routine problems; demonstrating procedures to follow in order to solve these problems; providing repeated examples to practise these procedures; and only providing space for answers, making no provision to record student thinking. In some lessons, a workbook was used to record student thinking, in relation to textbook work and other activities, which might have been better used with more teaching experience. The nature of the textbook and its use gave clear messages that mathematics is about the production of correct solutions, rather than the thinking involved in coming to a solution (Wood et al., 2006).

Support

My experience in entering full-time teaching is commensurate with the beginning teaching experiences of many novice teachers who teach casually, often for several years before taking on a permanent full-time position (Ramsey, 2000). The school in which I undertook this research was the third school in which I taught since graduating from university. In the first two schools I had taught in a part-time capacity, the first as a result of casual work which became a temporary position for the remainder of the year, the second as a permanent member of staff. In 2002 I commenced teaching, at the school in which I conducted this study, on a part-time basis teaching only mathematics. On approaching the principal requesting full-time work in the following year I was offered and accepted a four week casual block for the last weeks of 2002 and a full-time temporary maternity leave position for the school year in 2003.

At the end of 2002 I was included in an orientation session with other teachers who were commencing at the school in the following year. This session included a tour of the school, a distribution of policies and an introduction to the executive staff. At the beginning of 2003 the Stage 2 coordinator invited the Stage 2 teachers to an informal gathering to get to know each other prior to the commencement of school. This Stage coordinator left the school in Term 2 of 2003 and due to the inexperience of the staff on Stage 2, was replaced by a Kindergarten teacher who did not join the Stage, for the remainder of the year. Two weeks prior to school commencing I was given a previous Year 4 program. The mathematics program was useful and was used as a guideline in preparing my own mathematics program in that year, however, the programs for the other KLAs included units that did not fit within the teaching cycle for 2003 and were only useful as a guide to formatting. While my supervisors were pleasant and friendly, no support was offered in this year of teaching other than those mentioned above. In the course of the year I had two lessons observed by my supervisors, the normal practice for this school, in which I received positive and encouraging feedback on my lessons. My supervisors brought problems to my attention following the initial parent/teacher interviews and in relationship to the persistent difficulties experienced with one child in my class. I also made my supervisors aware of student difficulties or problems, where appropriate, for their action. Details of my daughter’s health problems were brought to the attention of the principal, to assist in her support, because she was a student at the school. No advice or support was offered for any of these situations and no follow-up given to see how I was coping with them.

In considering the degree of support I received as a beginning teacher, generally and in terms of my efforts to teach mathematics using reform-oriented pedagogy, the context of this study and my personal circumstances need to be taken into account. In 2002 I came into the school on a part-time basis which limited my interactions with other staff on Stage 1 and generally within the school. In 2003 I commenced the year with an injury which precluded my attendance at daily staff sessions and mealtimes for the whole of Term 1. This undoubtedly affected the development of collegial relationships over the period of the study, relationships which may have afforded support in my early teaching experiences.

My status as a novice may have been discounted due to my previous part-time teaching experience, PhD studies and/or mature age, restricting the support I might otherwise have been offered. Bullough and Knowles (1990) noted a “tendency to withhold assistance from older, more mature beginning teachers, believing they do not need or want it” (p. 110). Interestingly, Miller, Brown-Anderson, Fleming, Peele and Chen (1999) found, in their study of teacher stress, that teachers who felt supported by their supervisors experienced less stress and that teachers over 30 years of age with less than

15 years experience reported low levels of supervisory support and related higher levels of stress than other teacher groups.

Support for my efforts to implement reform-oriented practices was not available, to my knowledge, within the school in which I was teaching. Throughout the two years of teaching I was in contact with a small group of other beginning teachers and while we shared experiences and details of resources we had come across, nothing from these exchanges was of assistance in my efforts to improve my mathematics teaching. I was a member of AAMT (The Australian Association of Mathematics Teachers Inc.) and MANSW (The Mathematical Association of NSW, Inc.) throughout 2001 and 2002, attending one workshop and reading their newsletters and journals with interest. These were useful in enriching my vision of effective mathematics teaching and making me aware of other local teachers with an interest in improving the teaching of mathematics. However, they were inadequate in providing the support I needed to determine how to deal with my circumstances and make a start in my own teaching. In 2003, my membership to both organisations lapsed, due to the work overload experienced in this full-time year of teaching. With the impact of the workload I needed assistance in my workplace that required no extra time or effort to access.

The absence of a clear way forward

In the second year of teaching, in giving myself permission to concentrate on coming to terms with Year 4 mathematics content and only make general efforts to improve my teaching, no improvements in reform-oriented teaching practices were evident. We have seen that in doing this I actually reverted to a traditional model of teaching, supplemented by the use of manipulative materials, which reflected my original vision of self-as-teacher.

It is apparent from the first year of teaching mathematics part-time that despite my novice status, I was capable of making changes to my teaching in the direction of reform-oriented practice despite my natural inclination to teach traditionally. I was capable of reflectively working on elements of best practice to the benefit of my teaching when I had the time and energy needed to prepare and reflect on my teaching. However, this was not as straightforward as having a vision and translating it into teaching. Even having adequate time for preparation, I simply did not know where to start in what was a daunting task. This is not unusual, teachers often hold beliefs about teaching they simply do not understand how to transform into teaching practices (Beswick et al., 2006). Beswick et al. (2006) noted that in spite of teachers holding progressive views about education, many of them operate quite traditional classrooms.

The vision of reform-oriented teaching evidenced in the literature was so very different from my experiences as a student that I did not know what it would look like in my classroom. To be clear, I had seen a video-taped lesson where Penny Skinner, an Australian primary school teacher, had implemented a problem solving approach to mathematics with her infants class (NSW Department of School Education, Western Region, 1989). I had also undertaken two units of mathematics pedagogy at university, where the lecturers had used reform-oriented practices, in terms of providing non-routine problems as a basis for tutorial work. These problems were solved in small groups and discussed as a whole class with an emphasis on the processes involved in finding our solutions, rather than right or wrong answers. However, neither of these classrooms were similar enough to the ones in which I taught, to make my way clear.

In both of my years of teaching I conducted four one hour sessions of mathematics each week, using a compulsory textbook with children who were not familiar with reform-oriented teaching practices. In commencing teaching I was totally unfamiliar, and had no expectation, regarding the sort of thinking to expect from my students when approaching a particular topic. Although I was not confident in traditional mathematics pedagogy, I had more experience in it, as a student, than of reformed pedagogies. I was not adept at scaffolding discussions or at asking appropriate questions. More often than not, I needed to make written notes about the important points of a lesson and list appropriate questions, to make sure I covered the important ideas in a lesson. Skinner's (1990) lessons, in contrast, apparently involved teaching mathematics for the whole session between recess and lunch each day. There was no textbook used in her classroom and the children were obviously very used to the classroom routine because this was the second year, of two and a half years, she taught this class (Skinner, 1990). She was clearly very familiar with the mathematics content and confident in her pedagogy, familiar with student thinking and experienced in scaffolding discussion and asking probing questions (NSW Department of School Education, Western Region, 1989).

The lecturers teaching the tutorials in which I took part at university also evidenced experience in these aspects of content and pedagogy. While these tutorials were extremely valuable in modelling reform-oriented teaching practices, their context was very different from the primary and infants classes in which I taught. These differences included the involvement of 25 adult students who generally understood how to behave in a group, enthusiastically involved themselves in the learning activities provided without arguing over materials, contributed confidently in whole class discussions, were generally able to verbalise their thinking and able to ask their own searching questions. While not wanting to devalue these experiences, because they were very worthwhile, primary school classrooms involve "a whole system of management that goes along with teaching" (Worthy, 2005, p. 392), a context for implementing reform-oriented practices which is quite different from tutorial groups of interested adults.

Both of these experiences were extremely helpful in assisting me to develop a vision of effective mathematics classrooms. However, the differences in my circumstances in terms of the limited time available, mandated textbook use, disparate student expectations and behaviours, and limited teaching experience, left me with questions about a way forward. The challenge was how to bridge the gap between my vision of reform-oriented practice and the realities of my teaching context. Interestingly, the first link in bridging this gap came in the form of advice from a well known visiting mathematics education academic which encouraged reflection and the clarification of a way forward.

Deliberate focus was necessary

In being able to focus on only mathematics teaching in my first year, it is interesting to note that the most influential change made was the introduction of non-routine problems into Number lessons. This saw improvements in a variety of aspects of my teaching, including the scaffolding of more worthwhile discussions, the establishment and maintenance of improving pair and group work and the emergence of a worthwhile mathematics classroom culture. Students were expected to contribute to classroom discussions about investigations and problems they had solved and became increasingly adept at sharing their strategies. A very clear message about mathematics making sense and being about patterns came out of these sessions and students were encouraged to value their thinking as well as correct answers. While subsequent focus on discussions and assessment saw some improvement in these areas, the introduction of non-routine problems and investigations saw a much wider range of improvements.

In comparing my efforts from the first to the second year of teaching primary school mathematics, it became obvious that a general desire to teach in a reform-oriented manner was inadequate in assisting change and improvement. This was certainly evident in the second year of teaching when constrained by the workload and accompanying physical and emotional fatigue. However, even without these distractions from the task, as in my first year of teaching, this was also true. For me, a focus on changing normal teaching patterns had to be clear and specific in order to make improvements. This appears to be related to making the responsibility manageable rather than overwhelming, by breaking down the big picture of effective teaching into smaller manageable tasks. In reflecting on my improvements from a current perspective, I believe my teaching may have continued to improve with a specific focus on non-routine problems and investigations throughout the second year of teaching. This might simply have involved specifically programming non-routine problems for Number, as I had the previous year, for the whole year. Providing non-routine problems and investigations opens the classroom up naturally to the need for sharing solutions and talking about strategies. This in itself may have assisted with changing the nature of mathematics lessons in the second year of teaching.

Limitations of this study

The self-study nature of this research precludes making generalisations about the findings as they relate to all beginning teachers. However, the research literature clearly indicates that my experiences as a beginning teacher are not unusual or out of the ordinary. Where these connections can be clearly made between my experiences and those of other beginning teachers reported in the research literature, implications are drawn regarding what I, as a beginning teacher, consider was necessary to support my early efforts at implementing elements of quality teaching, in mathematics and across all KLAs and might be of benefit to beginning teachers generally. Where connections are not drawn, implications of what would have been beneficial for me are drawn and recommendations made regarding further research to determine whether these conclusions and implications are generalisable.

Implications

This study investigated the experiences of one beginning teacher endeavouring to implement a high quality of mathematics education in line with the recommendations of the mathematics education research literature. The issues that emerged have implications at the level of teaching generally and specifically in teaching mathematics.

From my experiences as a beginning teacher looking to provide the highest quality of mathematics education, I have come to the conclusion that I would have benefited from:

- The provision of frequent exposure to high quality models of reformed mathematics teaching in primary school classrooms as a student and beginning teacher.
- Assistance in bridging the gap between the vision of reform and the realities of teaching within the constraints of existing school cultures.
- Considerable relief from face-to-face teaching, not just for professional development or accreditation requirements but for significant opportunities to properly prepare for teaching across all KLAs.
- Collegial support including mentoring, preferably from a more experienced colleague who was like-minded in her understanding of effective mathematics teaching, providing technical and emotional support and constructive feedback.
- Recognition as a beginning teacher in terms of the support provided, despite having previous part-time experience, working in a temporary capacity and being mature aged.
- The provision of innovative programs to support my early efforts to teach in ways consistent with quality mathematics teaching, while coping with the difficulties of the beginning years of teaching.

The need for clear connections between theory and practice

It is important that preservice teacher preparation programs link theory with practice (Worthy, 2005), providing models of teaching consistent with constructivist theories of learning and encouraging the development of strategies that enable novice teachers to implement reform-oriented practices in the contexts of constraining school structures (Smith & Lowrie, 2001).

Models of reform-oriented teaching need to be provided, not only in the context of university tutorials but in primary classrooms, enabling student teachers to see realistic and achievable models of primary school mathematics teaching. All teachers require clear images of effective teaching in order to be able to undertake effective teaching themselves (Fraivillig et al., 1999). From my own experiences I would surmise that these models need to be demonstrated in a wide variety of classrooms, covering a range of age groups teaching in circumstances similar to the classrooms in which the student teachers involved could be expected to commence their careers. Ideally, these models would include examples of teachers undertaking reform-oriented practices while constrained by school structures, including mandatory textbooks, streamed mathematics groups, externally imposed examinations and traditional mathematics cultures. Associated teacher interviews and student teacher discussions would be beneficial in clarifying alternatives for beginning teachers in these situations. Preservice teachers need to see that reform-oriented teaching is valuable and manageable for children of all ages in a variety of contexts (Fraivillig et al., 1999).

Professional experience placements often discourage preservice teachers' exploration and development of reform-oriented teaching practices (NSW Ministerial Advisory Council on the Quality of Teaching, 1999; Rorrison, 2005; Zevenbergen, 2005). Cooperating teachers often utilise traditional teaching methodologies in mathematics (Zevenbergen, 2005) and it is not uncommon for preservice teachers to be told by some classroom teachers to ignore what they have learnt in university courses (McCormack & Thomas, 2003; Rorrison, 2005). Student teachers are constrained, not only by school cultures and structures but by needing to please their supervising teachers (Rorrison, 2005, 2006). My preservice and beginning career experiences of teaching are well represented in this literature. Preservice teachers need preparation for the possibility of these types of teaching experiences in professional experience placements and early career teaching (Smith & Lowrie, 2001).

Smith and Lowrie (2001) conducted a case study of a graduate teacher, having completed her undergraduate degree with developing confidence and competence in teaching mathematics for understanding, struggling with the constraints of her first school in continuing to use reform-oriented practices. Compulsory textbooks and streamed mathematics groups were imposed on this teacher without her input and were non-negotiable. The authors highlighted that this is typical of the types of situations in which beginning teachers find themselves and argue the need for teacher educators to seek to “bridge the cultures of the school and the university” (p. 32). They also maintained the necessity to prepare preservice teachers for such constraints, prior to commencing teaching. Rather than ignoring or focusing on the negative aspects of school constraints, preservice courses need to support the development of skills and strategies to explicitly deal with them, to encourage critical reflection and the translation of beliefs about teaching and learning into teaching practices.

While courses incorporating models of reform-oriented teaching have been shown to influence beginning teachers’ beliefs about and attitudes to mathematics and mathematics education (Biddulph, 1999; Hart, 2004; Mayers, 1994; Schuck, 1995), translating these effectively into teaching practices has not been as successful (Hart, 2004). The culture of traditional mathematics teaching is resistant to change (Clements, 2003; Mewborn, 2000). If mathematics education is to be effectively reformed in line with recommendations for quality teaching and the mathematics education literature, intensive efforts need to be made to assist experienced classroom teachers to see the potential and make specific changes to their practice in line with recommendations. Beginning teachers cannot be expected to do what more experienced teachers are apparently unable or reluctant to do. Beginning teachers would benefit from models of experienced teachers, teaching in ways consistent with quality teaching models and reform-oriented mathematics education, to support their own efforts to develop effective pedagogy (Zevenbergen, 2005). Beginning teachers will continue to struggle with implementing teaching that supports constructivist principles of learning until they are teaching in schools where reform-oriented teaching practices are the accepted norm (Bolick, 1996).

Programs that focus on implementing specific components of effective mathematics teaching

Clear images of effective mathematics teaching are necessary if teachers are to undertake these practices themselves (Fraivillig et al., 1999). However, in my own experiences of trying to implement reform-oriented pedagogy, having a clear image of these practices did not ensure a successful realisation of this image in my own teaching. Change was only achieved by a concerted and focused effort on one particular component of effective teaching, rather than a generalised approach.

For me, the introduction of non-routine problems and investigations in Number lessons was the most beneficial of the three areas of focus undertaken in the first year of teaching. While improvements were also seen as a result of concentrating on developing classroom discussions and assessment in later terms, the benefits of a problem solving approach saw roll-on benefits in a range of areas. From a problem solving approach to mathematics it might be expected that students would develop an understanding that mathematics makes sense, it is about patterns, some problems can have multiple solutions and people might work out their solutions differently. However, benefits were also evident in: improved classroom discussions; more effective group and pair work; a focus on mathematical processes rather than the reproduction of content, skills and procedures; a reduction in an emphasis on right and wrong answers; and a more positive mathematics classroom culture.

In considering the implications of my experience in benefiting most from a concerted and focused effort on one component of effective mathematics teaching, with considerable advances associated with the introduction of non-routine problems and investigations, I am unaware of any literature that would verify my experiences as typical of beginning or experienced teachers in trying to implement reform-oriented practices. Intuitively it would seem that breaking the complex and daunting ‘big picture’ of reform-oriented teaching into identifiable components and then into associated manageable tasks would improve the abilities of all teachers, regardless of experience, to undertake efforts to improve their mathematics teaching. The NSW model of pedagogy enables teachers to focus on particular elements of their practice in its framework (NSW Department of Education and Training, 2003e) and associated practice guide (NSW Department of Education and Training, 2003a), encouraging and enabling teachers to analyse and reflect on their own teaching, identifying areas to focus on for improvement.

From my perspective it would have been beneficial to have had preservice assistance in simplifying my route into reform-oriented practice. Perhaps this might have been achieved through utilising action research, focusing on one component of reform-oriented teaching, in professional experience placements. This approach may also have assisted in developing strategies and skills to bridge the gap between my university and school experiences of mathematics education. Action research has been shown to be effective as a means of improving teachers' practices (Anguiano, 2001; Gervasoni, 1999; Kember, 2000) and has been used effectively to assist beginning teachers make the transition from university to teaching (Atweh & Heirdsfield, 1998; Ginns, Heirdsfield, Atweh, & Watters, 1997, 2001). In this approach to the development of reform-oriented mathematics teaching, I would have received encouragement to be reflective on my teaching and learning, view my professional development as a mathematics teacher as being manageable despite being complex and see this development as requiring concerted and specific effort. "Learning how to teach takes practice that is carefully structured and supervised by experts" (Lave & Wenger; Evans cited in Worthy, 2005, p. 394). Encouraging preservice and beginning teachers to use reflective, research-based approaches to their teaching supports their development as professionals, improving the quality of their teaching and student learning.

The need for support

Beginning teachers who experience positive school environments report higher levels of career satisfaction (Mitchell, Scott, Hendrick, & Boyns, 1998;

Schuck, Brady, & Griffin, 2005), develop positive attitudes to teaching (Flores & Day, 2006), are more confident and are ranked as better teachers than those teaching in less supportive environments (Mitchell et al., 1998). An important component of a positive school environment is the support, information and encouragement offered by the school leadership (Flores & Day, 2006). However, in teaching “the tradition is that as a beginner you cope” (Ramsey, 2000, p. 65), with some educators apparently believing that “overcoming extreme challenges is a necessary part of learning to teach” (Worthy, 2005, p. 393). Many novices still encounter their first teaching positions as ‘sink-or-swim’ environments (McCormack & Thomas, 2003; Ramsey, 2000; Sparrow, 2000; The Tasmanian Educational Leaders Institute, 2002). In NSW government schools, despite the development of a comprehensive and well planned beginning teacher induction program, many beginning teachers are still not receiving quality induction into the profession (McCormack & Thomas, 2003). The continued lack of substantial and consistent support for all beginning teachers across all education systems and schools is well documented (McCormack & Thomas, 2003; Ramsey, 2000; Rossmanith, 2006). It might be said that there is an element of ‘luck’ in novice teachers’ first teaching placements, in terms of the vast range in the levels of support they may receive. With the high attrition rates of beginning teachers (Manuel, 2003a, 2003b; O'Brien & Goddard, 2006; Ramsey, 2000; Rossmanith, 2006; Worthy, 2005), it is vitally important to ensure that all novices receive support in the formative years of their careers, to ease their way into a very complex and demanding occupation and positively shape their future practice (Ramsey, 2000; Worthy, 2005). Well structured and supportive induction programs are important for all novice teachers in order to ensure they “attain a high standard of professional practice” (McCormack & Thomas, 2003, p. 125) and enable the best possible education for students.

My experience coming into full-time teaching resembles that of casual teachers, a very common way to enter the profession (Ramsey, 2000). I was in regular contact with six beginning teachers in this two year period and five of the six entered their careers in a casual capacity. While the recent NSW

Institute of Teachers accreditation policy (NSW Institute of Teachers, 2005b) requires casual teachers to be assessed for professional competence, in line with other beginning teachers, this process does not ensure support for teachers commencing their careers in this way. Often casual teachers work on an on-call basis for a period of time, taking on the full-time duties of a classroom for extended periods. Coming into the education system in this way makes them less likely than other beginning teachers to receive the support they need. Ramsey's (2000) review of teacher education recommended that standards and guidelines for beginning teacher induction be established and that these ensure a consistency of quality for all novice teachers, including those entering the profession as casual teachers.

As a beginning teacher my support needs were in line with those recorded in novice teacher literature involving: help with workload (Anderson et al., 2000; Brown & Borko, 1992; McCormack & Thomas, 2003; Rossmanith, 2006); emotional and technical support in teaching, both generally (Kelley, 2004; Lee, 1999; The Tasmanian Educational Leaders Institute, 2002) and specifically with reform-oriented mathematics pedagogy (Sparrow, 2000); and the provision of curriculum materials that support the development of reform-oriented practices (Fraivillig et al., 1999).

Reducing workload

When the hours and intensity of work are increasing for all teachers (Australian Bureau of Statistics, 1997, 2003; Independent Education Union of Australia, 1997; Naylor, 2001; Prichard, 2006), the increasing load for current beginning teachers, in a work culture which often gives them little or no allowance for being beginners, cannot be seen as anything but a danger to the retention of these teachers, to the quality of their teaching and the quality of the learning of their students. Teachers, beginning and experienced, become 'workers' rather than professionals in these circumstances, in order to cope with the enormity of their heavy workloads and responsibilities (Densmore cited in Brown & Borko, 1992).

A call for relief from face-to-face teaching as one form of beginning teacher support has been widespread over a long period of time (Hite & others., 1966; Huling-Austin, 1992; McCormack & Thomas, 2003; Ramsey, 2000; Rossmanith, 2006; Schools Council, 1990; Sparrow, 2000). Beginning teachers need more time than experienced teachers to come to terms with unfamiliar content, to plan high quality lessons and access high quality resources. This release time must involve more than opportunities for professional development, though this is important. It most certainly must not be simply to fulfil the extra requirements of accreditation. While this is a worthwhile and reflective activity for a beginning teacher, a perusal of the documents make it evident that it is a very time consuming activity (NSW Institute of Teachers, 2005b). It must be remembered that the reduction in workload required to support the beginning teacher is in fact supporting the quality of teaching provided by that teacher and hence, the quality of learning experienced by her students. “When educators cannot claim sufficient time and energy to prepare and deliver curriculum in an engaged way, the provision of quality education is compromised" (McLennan, 2006, p. 18). In view of the current emphasis on improving student outcomes by raising the quality of teaching (NSW Department of Education and Training, 2003e; The Tasmanian Educational Leaders Institute, 2002) it is essential that this type of support become an educational priority.

Support and mentoring

The accreditation procedure for beginning teachers, introduced for teachers commencing teaching in NSW since January 2004, has incorporated a compulsory form of supervision in order to complete the process (NSW Institute of Teachers, 2005b). This has benefits in providing a guaranteed level of supervision for novice teachers, ensuring that graduate teachers meet certain requirements before being accredited as professionally competent. However, this does not solve all the problems involved with providing adequate support for beginning teachers. My experience as a beginning teacher highlighted for me the need to be included in a collaborative school community with the particular support of a more experienced colleague. We have already seen the benefits of a positive school environment in terms of a novice teacher’s career satisfaction, confidence and performance (Mitchell et al., 1998). Effective mentoring is an important part of this supportive environment, having been found to increase the rate at which novices develop as “successful managers and instructors” (Stroot et al cited in Worthy, 2005, p. 382) and improving teacher retention rates (Bobek, 2002; Kelley, 2004).

My previous part-time teaching load in 2002, and the limitations of my mobility due to the injury sustained prior to commencing full-time teaching in 2003, may have affected the development of collegial relationships which could have afforded support throughout these two years of teaching. Collegial relationships support the development of effective teachers (Gratch, 1998; Stronge, 2002), reduce teacher isolation (Baker, 2003) and can foster the resilience of beginning teachers (Bobek, 2002; Tait, 2005). Schools can support the formation of collegial networks by encouraging team teaching, grade planning, peer coaching and mentoring (Tait, 2005).

Being inexperienced as a classroom teacher in commencing the full-time year of teaching, assistance would have been beneficial in a range of practical and emotional issues. I would have benefited from an experienced grade teacher’s input on issues such as: classroom structures and organisation; setting up and marking a roll; selecting class exercise books; seating arrangements; determining routines; establishing relationships with parents; the location of resources; preparing for parent/teacher interviews; organising routines and structures to assist accelerated students in their different classes; and fitting the whole school rewards system to the classroom behaviour management structure. It would have been beneficial to have had emotional support and advice from a more experienced teacher in that year, preferably someone not responsible for my supervision and evaluation. This would have been particularly helpful in coping with the impact of the medical concerns of my daughter and the continuing difficulties with one child in my class, but would also have been valuable throughout periods of increased stress such as programming, assessing and reporting.

In terms of my efforts to implement reform-oriented mathematics pedagogy in both years of teaching and teach all KLAs in 2003 using active learning strategies, support from a teacher experienced in, and committed to, supporting students' construction of knowledge through active learning would have been invaluable. Opportunities to share in the teaching experiences of a more knowledgeable and skilled advocate of quality teaching through active learning using team teaching, coaching and support would have been ideal in scaffolding my own early efforts. Assistance to identify and focus on student thinking and to address this in my teaching would have been extremely worthwhile in assisting in my own development and hence my students' learning.

Models of induction and mentoring are plentiful and in making recommendations for beginning teacher support I am aware that there is considerable disparity between the ideal and what is possible, for all teachers in all schools, in terms of the realities of costing such programs and the availability of mentoring teachers with experience in and commitment to reform-oriented mathematics pedagogy. Therefore, my recommendations are differentiated, in terms of what I consider to be essential to the support of all beginning primary school teachers and what I maintain is desirable for the development of their quality teaching practices, particularly in mathematics.

Beginning teachers should be provided with mentors who will provide practical and emotional support in the early years of teaching. In NSW government schools, mentoring programs are available for beginning full-time teachers (NSW Department of Education and Training, 2006). However, this does not ensure part-time or casual beginning teachers have this support or that these programs are administered consistently across all schools and educations systems (McCormack & Thomas, 2003; Ramsey, 2000; Rossmanith, 2006). While the establishment of informal mentoring relationships may occur naturally within the normal collegial relationships within a school (Holden, 2000), this does not ensure that all teachers enjoy the benefits of those relationships when entering their first jobs. Beginning teachers need to be assigned a mentor upon entering a school, responsible at the very least, for providing the necessary practical and emotional support. While some mentoring programs involve mentors who are supervisors and many of these relationships have been successful (Carter & Francis, 2000), from my own experience I would argue for the separation of the roles of supervisor/evaluator and mentor. Collegial relationships need to be established where novices are encouraged to approach their mentor for assistance or advice without fear of being judged inadequate or incompetent by someone responsible for making these assessments (Ewing, 2001; Kelley, 2004; Sparrow, 2000; Vonk, 1993).

From my perspective, an ideal induction program would fit with that described by Kelley (2004) in the Partners in Education (PIE) program[8]. This program aims to "frame induction around a vision of good teaching and compelling standards for student learning" (p. 442). PIE provides mentors who are not responsible for teacher performance evaluations and provide considerably more than emotional and technical support. They give practical assistance prior to school commencing and work with teachers in their classrooms, for half a day each week, for the remainder of the year. In this role mentors assess novices' needs and provide a range of support. This support may include: coaching, observing lessons and providing feedback; modeling instruction; team teaching; assistance with assessment; and organising opportunities for the novice to observe other classrooms. Mentors in this program are "chosen for their demonstrated teaching excellence, dispositions toward collaboration and inquiry, commitment to professional growth and change, and expertise in specific district and university priority areas such as literacy, mathematics, or classroom assessment" (Kelley, 2004, p. 442).

Innovative programs available

Nearly twenty years ago Berliner (1988) argued that beginning teachers should not be expected to be creative lesson planners at the most vulnerable

[8] Partners in Education (PIE) is an induction program jointly administered by the University of Colorado at Boulder (UCB) and six Colorado school districts.

time of their careers. He suggested that in their early years of teaching, novices should be supported by the use of manuals, lesson scripts and prototypes, regardless of the deficiencies of these resources. My experiences, in both my years of teaching, would lead me to the same conclusion.

The textbook was the only item provided in my two years of teaching that would fit within this type of support and its role was quite complex, being both a support and a constraint. It gave structure to my lessons when I commenced teaching in 2002, ensuring the content requirements were met and matched to the outcomes of the Syllabus (Board of Studies NSW, 1998), for both years of teaching. It provided the basis of my lessons in 2003 and while it contributed to largely traditional lessons it ensured that, despite being under enormous pressure due to the workload, my students experienced mathematics lessons commensurate to those provided in the classrooms around me. On the other hand, it constrained my efforts to teach mathematics for conceptual understanding, providing only routine problems and encouraging my students to see mathematics as facts, skills and procedures. The textbook restricted my efforts to build a classroom culture that valued thinking over right answers, by providing no room for the students to record anything other than their answers. While these difficulties can be reduced through using workbooks and diaries to record student thinking, the shortcomings of the textbook still remain.

The provision of a high quality innovative mathematics program, developed for the NSW Syllabus (Board of Studies NSW, 2002; NSW Department of School Education, 1989) would have gone a long way in addressing my problems with the textbook. I have not researched all of the materials developed to support the teaching of mathematics in Australia, and do not know whether these types of programs are available, knowing only that they are not available in the schools with which I am familiar. All of these schools use textbooks in a similar style to the one used in both my years of teaching and even when used with the guidance of the teacher resource manuals, would not be considered innovative or supportive of reform-oriented mathematics education.

In making this recommendation, without thorough research of what is available or desirable, I am listing the characteristics of a program that would have met the needs I had due to the enormous workload, my general inexperience and my inexperience with reform-oriented mathematics teaching. A resource better matched to my needs as a beginning primary school mathematics teacher would have provided:

- a thoroughly planned program that adequately covered Syllabus requirements, making connections to specified outcomes;
- individual lesson plans;
- a clear focus on the main idea of a lesson;
- non-routine problems and investigations as a basis of mathematics lessons;
- textbooks with journal qualities that allowed for students to record their thinking as well as their solutions;
- Black Line Master (BLM) resources where appropriate;
- background information and explanations with links to previous and future content;
- definitions of language;
- probing questions;
- extension activities;
- possible student thinking, including probable errors in thinking and suggestions in supporting students to overcome these; and
- suggested assessment activities.

New and experienced teachers, need more than images of reformed or quality teaching, they need assistance in attaining them (Anderson & Bobis, 2005). Fraivillig, Murphy and Fuson (1999) maintained that teachers looking to change their teaching in line with reform "need guidance in taking these steps" (1999, p. 13). Ma (1999) argued that textbooks and teachers' manuals can provide teachers with this guidance offering important information about content, pedagogy and student thinking and ensuring sequential coherence in the mathematics curriculum. “A thoughtfully and carefully composed textbook carries wisdom about curriculum that teachers can ‘talk with’ and that can inspire and enlighten them” (p. 148). Unless and until reformed teaching practices become the normal experience of school students who then become teachers, novice teachers (and experienced teachers) need structured and specific support if they are to develop teaching practices that are so alien to their own experiences. The provision of innovative mathematics programs may assist in this process, as Clarke (1997) noted in his case study, where the use of innovative teaching materials was a major influence on one experienced teacher’s professional growth in line with best teaching practice in mathematics.

Recommendations for future research

The following recommendations for further study have been drawn from the findings and implications of this study in order to: clarify whether my experiences are reflective of the experiences of other novice teachers where the literature is sparse; and provide further information for the continued development of courses to support preservice and inservice primary school teachers in the development of high quality, reform-oriented mathematics pedagogy.

Ramsey reported (2000) the recruitment of mature aged entrants to teaching as increasing the diversity of teachers and bringing a wealth of broad experience into schools. This report encourages incentives and extended pathways into teaching, to enable the recruitment of high quality mature aged preservice teachers. It also recommends a range of strategies to support all beginning teachers in their early careers. In considering the limited support I received in these two years of teaching, I consider it important that the beginning teaching experiences of mature aged novice teachers be investigated. My experience may have been circumstantial, related to one or all of the following factors: the school culture and staff; my personality and personal circumstances; PhD studies; original part-time status; and my difficulties in joining with other staff in the initial months of full-time teaching. On the other hand, it may have been common to many beginning mature aged teachers. Existing research regarding the early career experiences of mature aged novice teachers focuses on the effects of first careers and previous life experience on these teachers' entry into teaching (Haipt, 1990; Novak & Knowles, 1992; Resta, Huling, & Rainwater, 2001). Research focusing on their experiences as beginning teachers, the types and degrees of support they receive and the support they believe would assist them in their early careers, would be useful in planning for their preservice and inservice education and support.

The resistance of teachers, experienced and novice, to changing their practices in line with recommendations for mathematics education, has been well documented (Clements, 2003; Mewborn, 2000). In my experience, the most useful strategy used to improve the quality of my mathematics teaching involved identifying the components of effective mathematics teaching and focusing on the introduction of non-routine problems and investigations. There were roll-on benefits across a range of areas which improved both my teaching and student learning. Research into the benefits of this type of approach to scaffolding change, in both preservice and inservice teachers' practice, would be useful in informing efforts to support the development of quality mathematics teaching. It would also be useful to determine if, as in my experience, the introduction of one particular component is more successful, than others, in affecting change and improving teaching and learning. These insights would be useful in informing the design and implementation of programs to support the development of high quality mathematics pedagogy in both preservice and inservice teachers.

In recommending the introduction of an innovative program designed to support beginning teachers in implementing high quality, reform-oriented mathematics education in NSW schools, it is recognised that such a program needs to be research-based, developed and tested. I acknowledge that such programs, if they exist, are outside of my experience. I am aware that there are programs overseas that claim to be both innovative and reform-oriented, receiving both support and criticism in their own communities. The recommendation made from the findings of this study, is that a program well matched to NSW requirements, be designed or adapted, tested and implemented in an effort to support both beginning and experienced teachers to develop and utilise quality mathematics pedagogy in NSW classrooms.

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A novice primary school teacher's attempt to teach mathematics for understanding: A self-study

Volume 2

APPENDICES

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APPENDICES

Year 2 Mathematics Program, Term 1, 2002

Note: All names except those of my family are pseudonyms.

1: **YEAR 2 MATHEMATICS**

2: **Outcomes for Term 1** - taken from *Mathematics K-6: Outcomes and indicators* (Board of Studies NSW, 1998) in relation to *Mathematics K-6* (NSW Department of School Education, 1989).

3: **Working Mathematically:**

4: WM 1.1: *Asks questions about mathematics when using materials and in practical situations.*

5: WM 1.2: *Answers mathematical questions using objects, pictures, imagery, actions or trial-and-error.*

6: WM 1.3: *Explains simple mathematical situations using everyday language, actions, materials and drawing.*

7: WM 1.4: *Supports answers to mathematical questions by explaining or demonstrating how the answer was obtained.*

8: WM 1.5: *Recognises what worked and what did not work while answering mathematical questions.*

9: WM 1.6: *Uses the available technology to explore basic mathematical concepts.*

10:

11: **Number:**

12: N 1.1: *Approximates, counts, compares, orders and represents whole numbers and groups of objects up to 100.*

13: N 1.2: *Describes and models the relationships between the parts and whole.*

14: N 1.3(a): *Represents addition and subtraction facts up to 20 using concrete materials and in symbolic form.*

15: N 1.4(a): *Generates and describes number patterns using a variety of strategies.*

16: N 1.4(b): *Models numbers and number relationships in a variety of ways, and uses them in solving number problems.*

17: N 1.5: *Demonstrates an understanding of the monetary value of coins by using them in practical situations.*

18:

19: **Space:**

20: S 1.1: *Describes three-dimensional objects using everyday language, models and sorts them, and recognises them in drawings and* pictures.

21: S 1.2: *Recognises, names and makes simple two-dimensional shapes and describes their properties using everyday language by observing similarities and differences.*

22: S 1.4: *Represents the position of objects using models and sketches, and uses everyday language to describe their position.*

23: S 1.5: *Conducts simple data investigations and interprets the results using concrete materials with teacher guidance.*

24: S 2.5: *Gathers, organises, displays and interprets data and presents findings using column graphs.*

25:

26: **Measurement:**

27: M 1.1(b): *Responds to and uses everyday comparative language relating to mass when recording and communicating measurements.*

28: M 1.5: *Estimates, compares, orders and measures the mass of objects* using informal units.

29: M 1.6: *Uses informal methods to order the temperature of materials.*

30: M 1.7(b): *Locates events in time by referring to calendars, and reading clocks on the hour.*

31:

32:

33:

34: **TERM 1 PROGRAM**

35:

36: Year 2 Mathematics groups

37:

38:

39: **Week 1 and 2:** N 1.1; N 1.3(a); N 1.5; N 1.2; N 1.4(b); WM 1.2

40: Speed test every day.

41: Number

42: Revision:

43: Counting – p. 1.

44: No mathematics groups until Week 2 - this topic covered in class groups.

45: Addition 3 – Text p. 2.

46: Reading "*The Very Hungry Caterpillar*" (Carle, 1969) and associated adding activity (whole class).

47: Number balance activity (whole class).

48: Fractions and Decimals 1 – Text p. 5.

49: Sharing food between 2 people - bigger or smaller half not possible (cutting a whole into halves and dividing a group into 2).

50: Cutting and folding activities using a piece of paper and different shapes.

51: Sharing popcorn between 2 people.

52: Money 1, 2 and Addition 3 – Text p. 4.

53: 'What's missing' from p. 278 Syllabus (NSW Department of School Education, 1989)[1].

54: Dice game (pairs).

55: Subtraction 2, 3

56: Take away subtraction – Text p. 3.

57: Dice game.

58: Target practice game (p. 223 Syllabus).

59: Comparison subtraction

60: Word problem using diary to explain answer.

61:

62: **Resources**

63: Dice

64: Paper shapes

65: Paper

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[1] The syllabus referred to in the Appendices references is *Mathematics K-6* (NSW Department of School Education, 1989) unless otherwise specified.

66: Food

67: Popcorn

68: Number balance

69: *The Very Hungry Caterpillar* (Carle, 1969)

70: Coins

71:

72:

73:

74: **Evaluation:**

75: Addition 3

76: "*The Very Hungry Caterpillar*" (Carle, 1969) was a good introduction to the class.

77: Children fascinated with the number balance.

78: Fractions and Decimals 1

79: The concept of 'a half' being equal not bigger or smaller well covered.

80: All students handled the cutting and folding activities well.

81: Text page some evidenced difficulty.

82: Sharing popcorn was difficult for some - they just guessed.

83: Money 1, 2 and Addition 3

84: Plastic money is not all the same size - disappointing.

85: Subtraction 2, 3

86: Target practice game went well.

87: Some students had difficulty grasping the need to explain their thinking rather than give an answer in the diary activity.

88: **Detailed evaluation of first lesson 4.2.02:**

89: I was very frustrated with the lack of resources (e.g. Unifíx cubes were not available. I thought these were commonly available), and lack of knowledge about where to find them and the restrictions my time at the school has on locating appropriate resources. As a result feel like a 'pain in the neck', who is always asking for help when teachers have other things to do i.e. teach, prepare or eat.

90: My other frustration is that the room I have been allocated is the computer centre for the Year 1 and 2 classrooms, and it is located in the centre space between Years 1 and 2 (two of each). All the classrooms lead into it and I feel like I easily disturb other classes. I have a ‘fear’ of being perceived as having poor class control and so I suspect I will struggle with encouraging profitable active learning activities when I and the children are so easily heard by the other classes. My experiences in schools have led me to believe that teachers are very critical of other teachers who have noisy classes and often equate this with the teacher having poor class control. This is exacerbated by the extraction fan located in the skylight in the centre of the room. It is large and very noisy, and I cannot turn it off as it is inaccessible and on a timer. I spoke to the Infants coordinator and she did not have any solution.

91: I did not get through the activities I had planned to do, the time it took to deal with introductions, models, discipline and procedures (speed test books and textbooks). I have to cover the addition dice game tomorrow (with the unit on money) because I think the unit is very important to revise and the unit on money is not so vital (it has to do with the appearance of the coins).

92: I did not have a stopwatch, making it difficult to do a speed test.

93: I finished the lesson and spent 40 minutes cleaning up the room and marking the speed test (the children marked it and I checked their marking) and textbook (I marked it and made comments). This is very time consuming. If a classroom teacher spent that long on even two or three lessons the days marking would take an hour and a half.

94: I did not use the book as well as I intended. It was not my first choice as a basis for the lesson but again the problem I have locating resources was the reason for this. I need to organise things I want from the library well in advance as I don't know how to access library catalogues and so I will have to request the librarian to locate appropriate books.

95: I am so focused on classroom control, setting up the next activity and seeing that they run smoothly I am not really looking for student thinking in either their behaviour or responses.

96: **Detailed evaluation of second lesson 5.2.02:**

97: The group work did not go well. There was too much happening at once and too many students needing assistance all at once. I tried to change the setup when it became apparent I would need to go through each activity step-by-step as the children did them. It was also apparent my modelling and explanation at the beginning of the lesson was not sufficient. My change of plan had some benefits, but I was not happy with how it went. I will avoid rotating groups until the students are more settled and I am surer of their understandings of instructions.

98: We were pushed for time, the hour really is about 30 to 40 minutes when you exclude settling in, speed test, textbook completion and rewards for appropriate social behaviour at the end of the lesson.

99: **Detailed evaluation of third lesson 6.2.02:**

100: This lesson was really pressed for time. We did far too much, too many different activities.

101: Students generally had no trouble cutting up a shape without assistance. Some children had difficulty sharing the popcorn, there was 'too much' so a couple of children just made a rough guess. Most children however, either did "one for you, one for me" or counted them out (Hey, I just focused on student thinking!).

102: The text page was easy for most students except for the challenge which had shapes cut into four. A lot of children coloured in a quarter not a half (only one or two got it right using the lines provided). Some children got it right by ignoring the lines and drawing their own (see written notes for a diagram). Some children had difficulty with the group question, instead of dividing the balloons into two groups (showing a half of the group) they coloured in half of each balloon.

103: We covered the idea that there is no smaller or bigger half, a few students still struggled with this.

104: I have just remembered my desire to have students keep a mathematics diary, I will organise this tomorrow.

105: **Detailed evaluation of fourth lesson 7.2.02:**

106: I seem to be having more and more trouble fitting all I have programmed into the lesson. I must cut back and provide quality activities which promote quality thinking rather than lots of activities. How?

107: Some students had difficulty doing more than write down the answer to the word problem. I got students to model their thinking by drawing, and most of them had a reasonable go. Some children still had trouble, I need to model it clearly next week until they get the idea and can make a real effort of expressing their thoughts.

108:

109: **Evaluation of Week 2** 10.2.02

110: Assessment: I need to focus on this so I don't come to reporting time and struggle to assess fairly because of my very limited knowledge of the students.

111: I need to organise an assessment book (the school does not provide them so I need to make my own).

112: I need to focus on student thinking more, I am doing this, to a degree, in marking and I take notes, but I need to be more aware in lesson time.

113:

114:

115:

116: **Week 3:** N 1.1

117: Speed test every day.

118: Number

119: Numeration 9 - multiples of 10 (p. 203 Syllabus).

120: Counting and bundling.

121: 100s charts - patterns of 10s.

122: Counting by 10.

123: Text p. 9.

124: Tens and ones.

125: Calculators - patterns of 10s.

126: Counting by 10.

127: Text p. 12.

128: Making numbers - bundling 1 ten and ?

129: Counting by 10.

130: Recognition of multiples of 10 – symbols.

131: Text p. 13.

132: Introduce trading game.

133: Counting by 10.

134: Fill in multiples of 10 on scrap paper.

135: No text.

136:

137: **Resources:**

138: Paddle pop sticks

139: Counters

140: Elastic bands

141: Egg cartons

142: Base 10 material

143: Word problems

144: Calculators

145: Paper

146: 100s charts

147:

148: **Evaluation:**

149: Numeration 9

150: I left students to work out a way of presenting 40 so I could see it instantly - one group used 6 as the bundle.

151: The 100s charts activity was good, pattern was clear.

152: Children enjoyed using the calculators to find patterns and coped well.

153: In the counting by 10 activity using bundles, the bundles of 10 were still together from the previous activity, yet many children needed to unbundle them to count their answers.

154: The counting by 10 activity, out loud, went well.

155: When filling out multiples of 10 on scrap paper some students still not sure what the numerals look like for multiples of 10.

156: Overall: students need a lot more experience to see the need for 10s.

157: **Evaluation of Week 3:** Numeration 9, Multiples of 10.

158: The students need a lot more ‘bundling’ into groups of 10 experiences. I find time the biggest difficulty, because I'd like to give lots of experiences so that a substantial number of the children come to the realisation/conclusion that groups of 10 are ideal. The closest I got was with one pair of children bundling into groups of 6, another pair grouping into 2, and one pair into 25. We discussed these and I guided them with questioning, through what presentations were the easiest to see, but instead of having the opportunity to ‘discover’ groups of 10, I asked if there was a grouping which would be easier to add up and one child suggested 10 and we spoke about it.

159: Interestingly, after the children bundled into groups of 10 I handed the paddle pop sticks (which were mostly still bundled in groups of 10) out the next day and asked them to show me 23, and nearly half of the children unbundled the paddle pop sticks and counted them out, presenting them as one group or in other sorts of groups (2 groups - not tens - with leftovers). The children obviously do not understand the real point of bundling. Using MAB base 10 material, I am not sure these children really understand that a long is the same as 10 shorts. I wish we had Unifíx cubes because they are more representative of grouping and being able to see the 10 cubes at once rather than sticks which are bundled up together.

160:

161: **Week 4:** WM 1.2; WM 1.3; N 1.3(a); S 1.5; S 2.5;

162: Speed test every day.

163: Number

164: Addition 4 - addition combinations to 20 (p. 214 Syllabus).

165: Investigating number combinations to 20, recording and sharing - Text p. 14.

166: Add to 20 using pictures, counters, objects.

167: (Check if students are adding on).

168: Playground jump on paper – Text p. 21.

169:

170: Space

171: Graphs 1 & 2 - comparing groups of pictures representing objects or objects that represent other objects (p. 104-105 Syllabus).

172: Introduce graphing by using children to stand in columns depending on hair colour.

173: Children vote for favourite ice cream using coloured paper ice creams as representation of ice cream and sticking it onto make a column graph – Text p. 6.

174: Graph on board using number of letters in children’s names.

175: Graph of children’s month of birth using coloured paper squares in circle (pie) and columns.

176: Text p. 57.

177: **Resources**

178: Counters

179: Base 10 material

180: Scrap paper

181: Pictures

182: Objects

183: Playground jump drawn with chalk - 6 groups

184: Eye stencils

185: Coloured paper circles (brown, pink, white)

186: Post-it notes

187: Bluetac

188: Coloured pencils

189: Scissors

190:

191: **Evaluation:**

192: Addition combinations to 20

193: I feel counters are not the ideal material for investigating number combinations, Unifix cubes are ideal but unavailable. We only did 11, 12.

194: The playground activity went quite well - will do again.

195: Space: Graphs 1 and 2.

196: The graphing activity using the children went well.

197: Using coloured paper to represent ice creams went very well.

198: Making a graph on the board using post-it notes to represent the number of letters in children's names went very well.

199: So too did graphing the children's month of birth using paper squares.

200: Overall: the active learning experiences went well. The textbook work was not as good. Logistics were difficult for the pet graph on Text p. 57. There were language difficulties. i.e.

201: Writing a question rather than an answer was too difficult for some students.

202: **Evaluation of Week 4:**

203: Addition combinations to 20

204: How I wish I had Unifíx cubes to 'show' the patterns. We only did 11, 12 but it was so quick and the counters were not completely suitable. Some children didn't bother with them, some flicked them or played with them.

205: Space: Graphs 1 and 2

206: The active learning experiences e.g. hair colour using themselves leading onto the flavour of their favourite ice cream using coloured circles on the board leading onto the month of their birth using big coloured squares on the floor leading onto the number of letters in their names on post-it notes went very well. BUT the textbook went on to a task I felt was beyond the group (logistically at least) about the pets the children owned and colouring in a box for each pet. It asked the children to make up questions about a graph, many of them could only write answers. I don't know if this is a language issue or an 'answer' approach to mathematics being evident.

207:

208:

209: **Week 5:** WM 1.1; WM 1.2; N 1.4(b); N 1.3(a); M 1.6; M 1.1(b)

210: Speed test every day.

211: Number

212: Subtraction 4: subtraction involving comparison (p. 224 of Syllabus).

213: Real life problems, involving comparison subtraction, solved with the real objects.

214: Comparison word problems solved with concrete materials representing real objects – Text p. 17.

215: Comparison word problems solved with concrete materials and operation - numeration cards.

216: Connections made between addition and subtraction.

217: Text p. 18.

218:

219: Measurement

220: Temperature 3: Awareness of the need for a temperature measuring device (p. 169 of the Syllabus).

221: Predicting the temperature and then testing by eating a sausage roll, lolly and iceblock.

222: Looking hot/feeling hot – precautions.

223: Text p. 7.

224: Pictures sorted in order of likely temperature.

225: Feel and order objects according to temperature.

226: Talk about situations where people measure temperature other than by feel.

227: Text p. 40.

228: **Resources**

229: Counters

230: Balls

231: Quoits

232: Operation/numeration cards

233: Overhead projector

234: Food

235: Pictures

236: Objects of differing temperatures

237: **Evaluation:**

238: Number: Subtraction 4

239: The learning experiences went well though some students will add the two numbers rather than find the difference. Drawing the connection between addition and subtraction was much more difficult as evidenced in textbook work. Only 6 or 7 students appear to have made any connection.

240: This involved comparison, drawing the connection between addition and subtraction is an outcome for first semester. I will be surprised if this happens for most of my students, they are not ready to see it, they need lots of experiences.

241: The textbook is frustrating me again. The emphasis on formal algorithms e.g.

242: 1 + 2 = 3

243: 3 - 1 = 2

244: 3 - 2 = 1

245: This is beyond where most of the children are, and gives them no opportunity to ‘discover’ the real connections. I tried to scaffold this by providing operation and numeral cards and letting them play around with words and algorithms, but they need a lot more experiences (only six or seven students appear to have made any connections).

246: Measurement: Temperature 3:

247: The opportunity to predict was not there - but the students understand the basic concepts of temperature and the associated language.

248: Problems experienced by a few in textbook work - may be language/reading problems not understanding.

249: We had a ‘food’ introduction organised by another teacher so I missed the opportunity for prediction and discussion before eating. I don't think the activity was much more than enjoyable, there were not a lot of learning opportunities.

250: Textbook work showed some children having difficulties, but it may well be reading related not difficulties of understanding the concepts.

251: On the second day I had ‘cold’, ‘colder’ and ‘coldest’ experiences with water and each child had the opportunity to feel and rank the containers. Most children had no difficulty doing this properly (though a few were being deliberately different in their rankings). This was a worthwhile activity, as well as giving language experiences.

252:

253: **Week 6:** WM 1.3; N 1.2; S 1.4

254: Speed test every day.

255: Number

256: Fractions and Decimals 1: Part/whole relationships (p. 263 of Syllabus).

257: Revise the concept of half.

258: Making half and half again using paper and scissors + placing on full piece of coloured paper.

259: Dividing a group of counters between four.

260: Cutting fruit into quarters – Text p. 16.

261: Space

262: Position 2: language of position.

263: Position 3: modelling and sketching the position of objects.

264: Space 2D4: arranging shapes (pp. 73, 97, 98 of Syllabus).

265: Play position games using themselves and objects.

266: Text p. 10.

267: Modelling.

268: Using position language using pictures.

269: Text p. 11.

270: Whole class modelling.

271: Whole class drawing on whiteboard.

272: Students complete directed drawing from positional language - Text p. 24.

273:

274: **Evaluation:**

275: Number: Fractions and Decimals 1

276: Fractions and Decimals 1: Part/whole relationships - went well as an activity though several children having trouble with halving half (some just kept going – halves, quarters, eighths, sixteenths...). We ran out of time for fruit activity. Counters went well - nearly all counted them out one at a time into each pile.

277: I still keep ‘over’ programming and running out of time.

278: The activity using two different coloured papers (cutting one and comparing it to the full sheet) was good. Some students just kept cutting and ended up with 8ths and 16ths.

279: Students shared the counters out one by one (one for you, one for you, one for you, one for you) generally and we talked about what to do with any leftover (cut up or put to the side), so we got into discussion. I know this was not the aim, but I hadn't given out counters in numbers divisible by 4 but just in handfuls. I am not sure whether I did the right thing here. Should I have made sure there were equal shares or not???

280: Space: Position 2, 3 and 2D4

281: The paper ribbons to be used on the children's right hands were inadequate for the job (some kept coming off) and need to be ribbon.

282: The use of elastic bands was fine with a very directive talk about leaving them alone except for the activity.

283: We had two days of modelling on desks using 4 or 5 objects. There was improvement in the children's ability to undertake the task on the second day.

284: Hokey Pokey went well. We used paper ribbon on right hand.

285: Modelling - saw improvement on second day. Children seemed to enjoy these activities.

286:

287: **Week 7:** N1.4(b); N 1.3(a); M 1.7(b); M 1.7(a)

288: Speed test every day.

289: Number

290: Subtraction 4: Subtraction involving comparison (p. 224 of Syllabus).

291: Counting on activities using operation and numeral cards and making connections between addition and subtraction.

292: Text p. 25.

293: Counting on activities and recording number sentences making connections between subtraction and addition - Text p. 26.

294: Measurement

295: Time 8: o’clock (p. 183 of the Syllabus).

296: Revise digital times of o’clock.

297: Introduce analog o’clock times using clocks children have made – Text p. 19.

298: Match times to activities during the day and continue to do so throughout the year using clocks children made (not done) – Text p. 51.

299: **Resources:**

300: Operation and numeral cards

301: Counters

302: Analog clock

303: Digital clock

304: Paper plates

305: Pipe cleaners

306:

307: **Evaluation:**

308: Subtraction 4

309: Subtraction involving comparison - A lot of children had real problems making connections between - and +, they need more experiences.

310: Measurement: Time

311: Clock activity was physically difficult for children, the hands kept breaking using the split pins, so we didn't really use them.

312: O'clock seems generally understood, by the children, on analog clocks, with a few exceptions.

313:

314: **Week 8:** WM 1.3; WM 1.1; N 1.1; N1.4(a); S 1.1

315: Speed test every day.

316: Number

317: Numeration 9:2-digit multiples of 10 (p. 203 of the Syllabus).

318: Counting by 10s.

319: Making multiples of 10 using paddle pop sticks and base 10 materials.

320: Trading game - Text p. 22.

321: Patterns with the number chart counting by 10s.

322: Patterns with the calculator counting by 10s.

323: 10 times table on tape (not done) - Text p. 29.

324: Space

325: Space 3D3: Investigating the properties of 3D objects (p. 55 of the Syllabus).

326: Mystery bag.

327: Object sort - classifying shapes.

328: Draw a shape - finding shapes in the environment.

329: Name basic shapes - Text p. 20.

330: **Resources:**

331: Paddle pop sticks

332: Base 10 material

333: Dice

334: Number charts

335: Times table tape

336: Mystery bag and objects

337: Objects for sorting

338: Attribute blocks

339:

340: **Evaluation:**

341: Numeration 9

342: Still a long way to go for general understanding though a large group have a reasonable grasp of these.

343: Space 3D3

344: Children loved the mystery bag but not enough time. Textbook took a long time. Object sort excellent. Groups worked well.

345: 3D net making into a cube was not programmed for and was too difficult for the children. Not appropriate at this stage.

346:

347: **Week 9:** WM 1.5; N 1.1; N 1.3(a)S 1.2

348: Speed test every day.

349: Number

350: Numeration 5: The numbers 1 to 9 - using ordinal names.

351: Car or snail race - labelling positions.

352: Text p. 23.

353: Addition 4: Addition combinations to 20.

354: Word problems solved using concrete materials.

355: Text p. 30.

356: Space

357: Space 2D4 (arranging shapes) and 2D7 (investigating the properties of 2D shapes) (pp. 73 and 76 of the Syllabus).

358: Pattern blocks and cards - Text p. 27.

359: Geoboards - create and copy shapes.

360:Dot paper (not done) - create and copy shapes - Text p. 28.

361: **Resources:**

362: Toy cars or snails

363: Counters

364: Pattern blocks and cards

365: Geoboards and elastics

366: Dot paper

367:

368: **Evaluation:**

369: Numeration 5

370: Car race was an excellent activity - whole class. Lots of fun!

371: Addition 4

372: We used counters - a lot of children have difficulty staying on task and not just playing with the materials.

373: Space 2D4

374: We used dot paper activity in textbook instead of on dot paper.

375:

376: **Week 10:** WM 1.1-1.4; WM 1.6; N 1.4(b); S 1.1; M 1.1(b)

377: Speed test every day.

378: Number

379: Multiplication 1 (modelling equal groups of objects) & 2 (repeated addition to find total number in groups or rows) (p. 237 and 238 of Syllabus).

380: Making the same number in groups using concrete materials.

381: Labelling these groups using word and number cards - Text p. 33.

382: Making the same number in groups using concrete materials and labelling using word/number/symbol cards - Text p. 34.

383: Space

384: 3D4 (investigating the properties of 3D objects) (p. 56 of the Syllabus).

385: Investigating the shapes that can be made using pipe cleaners e.g. curved, straight curly etc.

386: Making animals, people, flowers and patterns using pipe cleaners - Text p. 35.

387: Measurement

388: Mass 5 (the equal arm balance) (p. 156 of the Syllabus).

389: Free play with equal arm balance in groups throughout the week.

390: Balance investigations - Text p. 36.

391: **Resources:**

392: Counters

393: Bottle tops

394: Pencils

395: Numeral/operation cards

396: Pipe cleaners

397: Equal arm balances

398: Objects to balance

399:

400: **Evaluation:**

401: Number: Multiplication 1 and 2:

402: Children can do this quite well concretely. Some are having trouble labelling - getting number of groups mixed up with number in a group. This is particularly evident in textbook work.

403: Space: 3D4:

404: This was done in the children's regular classes.

405: Measurement: Mass 5:

406: With Easter this did not happen.

407:

408: **Week 11:** WM 1.2; WM 1.4; N 1.3(a); N 1.4(b); N.1.1

409: Speed test every day.

410: Number

411: Subtraction 5 (subtraction to 20) (p. 225 of the Syllabus).

412: Subtraction activities with concrete materials using numeral/operation cards both vertically and horizontally Text p. 31, 32.

413: Numeration 10 (numbers 20-99) (p. 204 of the Syllabus).

414: Play the trading game to reinforce place value.

415: Use place value charts to count forwards and backwards between 20-99 - Text p. 37.

416: **Resources:**

417: Counters

418: Numeral/operation cards

419: Dice

420: Base 10 material

421: Place value charts

422: Assessment tasks:

423: Signs of progress 1A and 1B - Text pages 38 and 39

424:

425: **Evaluation:**

426: Number: Subtraction 5:

427: Vertical subtraction activities are no more of a problem than horizontal subtraction activities.

428: The activities were done in pairs, it went well, but lots more experiences are needed.

429:

430: **Evaluation of Term 1:**

431: The textbook takes over. On some days the activities on one page can take half an hour. It becomes very teacher directed, modelled and explained.

Year 2 Mathematics Program, Term 2, 2002

Note: All names except those of my family are pseudonyms.

1: **YEAR 2 MATHEMATICS**

2: **Outcomes for Term 2** - taken from *Mathematics K-6: Outcomes and indicators* (Board of Studies NSW, 1998) in relation to *Mathematics K-6* (NSW Department of School Education, 1989).

3: **Working Mathematically:**

4: WM 1.1: *Asks questions about mathematics when using materials and in practical situations.*

5: WM 1.2: *Answers mathematical questions using objects, pictures, imagery, actions or trial-and-error.*

6: WM 1.3: *Explains simple mathematical situations using everyday language, actions, materials and drawing.*

7: WM 1.4: *Supports answers to mathematical questions by explaining or demonstrating how the answer was obtained.*

8: WM 1.5: *Recognises what worked and what did not work while answering mathematical questions.*

9: WM 1.6: *Uses the available technology to explore basic mathematical concepts.*

10:

11: **Number:**

12: N 1.1: *Approximates, counts, compares, orders and represents whole numbers and groups of objects up to 100.*

13: N 1.2: *Describes and models the relationships between the parts and whole.*

14: N 1.3(a): *Represents addition and subtraction facts up to 20 using concrete materials and in symbolic form.*

15: N 1.3(b): *Uses a range of strategies to recall addition and subtraction facts up to 20.*

16: N 1.4(a): *Generates and describes number patterns using a variety of strategies.*

17: N 1.4(b): *Models numbers and number relationships in a variety of ways, and uses them in solving number problems.*

18: N 1.5: *Demonstrates an understanding of the monetary value of coins by using them in practical situations.*

19:

20: **Space:**

21: S 1.1: *Describes three-dimensional objects using everyday language, models and sorts them, and recognises them in drawings and pictures.*

22: S 1.2: *Recognises, names and makes simple two-dimensional shapes and describes their properties using everyday language by observing similarities and differences.*

23: S1.3: *Recognises, explains and uses objects and symbols to produce patterns.*

24:

25: **Measurement:**

26: M 1.1(a): *Recognises what features of an object can be measured.*

27: M 1.1(b): *Responds to and uses everyday comparative language relating to mass when recording and communicating measurements.*

28: M 1.2(a): *Estimates, compares, orders and measures the length of objects and the distances between objects using informal units.*

29: M 1.2(b): *Recognises the need for a standard unit of length and estimates and measures the length of objects to the nearest metre.*

30: M 1.4: *Estimates, compares and orders the capacity of containers using informal units.*

31: M 1.5: *Estimates, compares, orders and measures the mass of objects using informal units.*

32: M 1.6: *Uses informal methods to order the temperature of materials.*

33: M 1.7(b): *Locates events in time by referring to calendars, and reading clocks on the hour.*

34:

35:

36:

37: **TERM 2 PROGRAM**

38: Year 2 Mathematics groups

39: **Week 1:** N1.5; WM 1.2

40: Basic facts investigation and/or basic fact practice every day.

41: Number

42: Money 2 & 3. Text pp. 41, 62.

43: The face value of the notes and coins and trading amounts of up to $2 using coins.

44: Recognising coins and notes.

45: Adding amounts using coins as whole class and partner activities.

46: **Resources**

47: Play money

48: Counters

49:

50: **Evaluation:**

51: We did facts of four this week.

52: Money 2 & 3

53: Video-taped.

54: The plastic money at school is not a great representation of real money. Some coins do not have the Queen on them. The activity of one child buying and other child selling and working out how many coins to pay was a good one, but I made it a little too difficult. The children need more experiences in this.

55:

56: **Week 2:** N1.1; N1.4(a); WM1.1; WM1.3; WM1.4; WM1.5; S1.2

57: Basic facts investigation and/or basic fact practice every day.

58: Number

59: Numeration 10. Text pp. 42, 48.

60: Numbers 20 to 99.

61: Trading game.

62: Modelling game.

63: Space

64: Space 2D 7 &11. Text pp. 43, 44.

65: Investigating the properties of 2D shapes. Classification and construction of 2D shapes.

66: Tangram constructions - We didn't have enough time to do this.

67:

68: **Resources**

69: Base 10 material

70: Dice

71: Numeral and symbol cards

72: Place value charts

73: Counting squares

74: Tangrams

75:

76: **Evaluation:**

77: We did facts of five this week. Many children are struggling with the patterns.

78: Numeration 10

79: I need to make some numeral expanders. Students are generally improving in their understanding (several had trouble with 17 and 70). Textbook took 20 to 30 minutes.

80: School camp meant no time for hands-on activities with tangrams, just textbook work.

81:

82: **Week 3:** N1.3(b); N1.4(b); WM1.2; WM1.4; M1.4; WM1.5; M1.1(b); WM1.6

83: Basic facts investigation and/or basic fact practice every day.

84:

85: Number

86: Subtraction 5. Text pp. 45, 55.

87: Subtraction to 20.

88: Subtraction word problems using concrete materials.

89: Subtraction word problems using calculators.

90:

91: Measurement

92: Volume 5 & 6. Text pp. 50, 68.

93: Measurement of capacity with informal units.

94: Ordering containers according to capacity.

95: Measuring and comparing quantities.

96: **Resources:**

97: Counting squares

98: Numeral and symbol cards

99: Word problems

100: Calculators

101: Containers

102: Sand

103: Water

104: Unifix cubes

105:

106: **Evaluation:**

107: Facts of 6 investigated this week. - Quite a few students still struggling with patterns.

108: Number: Subtraction

109: Page 45 was okay but page 55 was a real struggle. There was just too much to do for a lot of the students, especially with larger numbers and having to count them out.

110: The non-routine problem lesson (e.g. Farmer Brown had three eggs in his basket, how many did he have and what happened to the others?) was excellent. The children, while a little confused to begin with, not understanding the question, came up with some terrific solutions and stories to go with them (e.g. he had 9 eggs and a snake ate 6 of them). I had to model a solution to enable the children to see what the problem was asking. Several children indicated there was not enough information to be able to answer the question. It was great to see how enthusiastically their responses changed after I modelled an answer (Farmer Brown had 4 eggs, he used 2 to make his breakfast, now he has 2 left). I felt this was my first real attempt at posing non-routine problems, and it went really well. The children did lots of subtractions in answering the question, there was not just one solution. The children had to decide what operation to use to work out an answer, as well as the story to go with it. It was great!

111: Volume 5 & 6

112: We didn't do page 50 because we didn't have the equipment but spent considerable time on page 68. Students enjoyed the activity, and were able to estimate, measure and compare three capacities.

113:

114: **Week 4:** N1.2; N1.4(b); WM1.2; WM1.3

115: Basic facts investigation and/or basic fact practice every day.

116: Number

117: Fractions and decimals 1 & 2. Text pp. 46, 47.

118: Part/whole relationships.

119: Fractions, equal parts.

120: Using concrete materials to divide groups into halves and quarters.

121:

122: Multiplication 2. Text pp. 52, 53.

123: Repeated addition to find the total number of objects in groups or rows.

124: Using concrete materials in ‘groups of’ and ‘rows of’ word problems.

125: Use numeral and symbol cards to represent word problems, including ‘x’ symbol.

126:

127: **Resources**

128: Counting squares

129: Base 10 material

130: Objects

131: Numeral and symbol cards

132: Unifix cubes

133:

134: **Evaluation:**

135: Basic facts investigation of seven this week. The children are improving in their understanding of patterns.

136: Fractions and decimals 1 & 2

137: We started the fractions and decimals activity as a whole class, using groups of different objects, for example: scissors, paddle pop sticks, counting squares, people. The class decided that some things can't be cut in half if one is left over (e.g. people). P. 46 deals with the concept of ‘a half’ while p. 47 deals with the concept of ‘a quarter’. Students were much more successful with the concept of a half. There was not a real understanding of quarter being an equal group.

138: Multiplication 2

139: Page 52 took one half an hour to complete and I took a group of six students through it individually. Other students completed the page themselves, but a few still have problems (Matisse to come to me next time).

140: An open-ended problem was given to early finishers.

141:

142: **Week 5:** N1.2; WM1.5; S1.1; WM1.3;

143: Basic facts investigation and/or basic fact practice every day.

144: Number

145: Fractions and Decimals 1 & 2. Text p. 59.

146: Part/whole relationships.

147: Fractions, equal parts.

148: Using concrete materials to divide groups of objects.

149: ASSESSMENT TASKS ON NUMBER

150: Space

151: Space 3D5. Text pp. 65, 66.

152: Investigating the properties of 3D objects.

153: Examine and discuss 3D shapes. Look at properties.

154: Introduce vocabulary.

155: **Resources**

156: Counting squares

157: Objects

158: 3D objects

159: Unifix cubes

160:

161: **Evaluation:**

162: Whole class exploration of Basic facts (not sure which number it was) was good.

163: Fractions and Decimals 1 & 2

164: I need to make ‘1/2’ and ‘1/4’ cards for the children's packs of symbols.

165: Fractions went quite well, I used non-routine problems e.g. "I have some white squares in my box. They are one quarter of all my squares, the rest are coloured. How many white squares have I got? How many squares all together?". The children had lots of different answers and got the mathematics thinking right. They wrote their responses on the board (working in pairs) and checked each other's results. We then looked in my box and saw who had come closest, while talking about everyone's answer as being ‘right’.

166: However, when completing the text pages the concept of one quarter was still difficult. Some children were confused with one half, or in fractions of groups of objects ‘just a little bit’ (1/12 of a set).

167: Space:

168: For first lesson we passed around about 30 3D shapes and felt them. We then talked about their characteristics. This went well.

169: The text page was okay, the concepts of hollow/solid were understood by nearly everyone.

170: 3D shapes activity was done in groups. Each table had a different shape on it. The class worked in table groups and moved from one table to another, completing the text page as they went. This went very well. This lesson was observed by my supervisor.

171: In the second lesson we used five objects, as in the textbook, and counted the attributes. We then placed the objects in a mystery bag, and a child had to describe to the class what he could feel in the bag, by describing its attributes. This went quite well.

172:

173: **Week 6:** M1.6; S1.2; M1.3; M1.1(a); M1.1(b)

174: Basic facts investigation and/or basic fact practice every day.

175: Measurement

176: Area 3. Text p. 61.

177: Comparison of two areas.

178: Covering surfaces.

179:

180: Temperature 3. Resource book p. 125.
181: Awareness of the need for temperature measuring device.
182: Comparing temperatures of objects.
183:
184: Space
185: 2D7. Resource book p. 56.
186: Investigating the properties of 2D shapes.
187:
188:
189: MASS ASSESSMENT USING SCALES
190: **Resources:**
191: Attribute blocks
192: Objects of differing temperatures
193: Paper shapes to cover
194: Equal arm balance
195: Objects for mass assessment
196: Counters
197: Counting squares
198: Unifix cubes
199:
200: **Evaluation:**
201: Measurement: Area 3
202: Page 61 is not related to the outcome for this term. This page was inappropriate. It doesn't make the concept of area clear.
203: The text page was so simple, it had inappropriate ‘big’ and ‘little’ pictures, the answers were so obvious. The outcome for assessment purposes was to do with the informal units of measure, this was totally different.
204: I ended up doing formal units of measuring area as part of an assessment test, as I also did for another outcome about calendars. This is unfair really.
205: The comparison of two areas was done as part of the assessment.
206: Measurement: Temperature 3
207: Temperature 3 was not done, assessment was done instead.

208: Space: 2D 7

209: 2D 7 was not done, assessment was done instead.

210: Assessment:

211: I did group assessment setting up equipment and tables with children numbered 1, 2, 3, 4. Children rotated to four different activities and I checked their responses to each activity. This was too difficult and stressful, we didn't get halfway through it. As a result we could not get to do Temperature 3 or 2D7 Space as detailed in the program.

212:

213: **Week 7:** N1.4(b); N1.3(a); WM1.2; WM1.3; N1.3(b); S1.3

214: Basic facts investigation and/or basic fact practice every day.

215: Number

216: Addition 4 & 5. Text pp. 64, 67.

217: Addition combinations to 20.

218: Memorisation of addition facts.

219: Solving word problems with concrete materials.

220: Doubling and near doubling using concrete materials.

221:

222: Space

223: Space 2D3 and 2D5. Text p. 56.

224: Recognising line symmetry.

225: Investigating symmetry in patterns.

226: Make and discuss symmetrical patterns and pictures by hand and computer.

227:

228: **Resources:**

229: Numeral and symbol cards

230: Counting squares

231: Paint

232: Paper

233: Computer drawing program

234:

235: **Evaluation:**

236: Addition 4 and 5:

237: A substantial part of the class understood doubles, but had difficulty identifying a ‘near’ double in their basic facts practice (only about six children could).

238: Addition activities using concrete materials and non-routine problems were okay (A child scored nine goals in two games, how many goals in each game?).

239: The students are very good using concrete materials.

240: Space 2D3 and 2D5:

241: Page 56 was completed quite well. A few students still do not understand symmetry. We need more time for computer work.

242: We did computer pictures, but there was not enough time. It was a good activity. I must make more time for these things.

243:

244: **Week 8:** N1.1; N1.4(a); WM1.2; M1.2(a); M1.2(b)

245: Basic facts investigation and/or basic fact practice every day.

246: Number

247: Numeration 11. Text pp. 69, 72, 76.

248: One hundred.

249: Use hundreds charts for counting by 1s, 2s, 5s, 10s.

250: Measurement

251: Length 6 & 7. Text pp. 70 & 71.

252: Informal units of length.

253: Awareness of the need for a standard unit.

254: Revise the process of measuring length.

255: Measuring objects in the room using informal units.

256:

257: **Evaluation:**

258: Numeration 11

259: There was lots of verbal practice, some children using hundreds charts.

260: Three groups of eight children rotated through three activities:

261: 1. Text page on multiples of 10 and modelling.

262: 2. Finding patterns with 100s charts and counters.

263: 3. Hundreds charts puzzles.

264: All three activities went really well, but I needed to tie things up better.

265: The puzzles are an excellent resource for early finishers, I need more of this kind of thing.

266: Length 6 and 7:

267: The length activities were very structured but the children ‘did’ it all including perimeter. The two text pages were completed in one day, it was all hands on measuring, this was too much. This was a very teacher directed lesson although very ‘hands-on’. I think it was a good learning experience for the children, though not through non-routine problem solving. I needed more time to tie together, and get children to share their findings, leading to the need for using the same units and the different results you get when you don't use the same units.

268:

269: **Week 9:** N1.3(b); N1.4(b); WM1.3; M1.7(b); M1.5

270: Basic facts investigation and/or basic fact practice every day.

271:

272: Number

273: Subtraction 6 and Addition 5. Text pp. 75, 77.

274: Subtraction facts to 20.

275: Memorisation of addition facts.

276: Revise addition and subtraction concepts using counting squares, games and bingo.

277: Space

278: Time 8. Text p. 63.

279: Time - o’clock

280: Using both digital and analog clocks for o’clock times.

281:

282: Measurement

283: Mass 5 & 6

284: The equal arm balance.

285: Measurement with informal mass units.

286: Revise mass using informal units and equal arm balance.

287: **Resources:**

288: Counting squares

289: Bingo cards

290: Dice

291: Digital and analog clocks

292: Unifix cubes

293: Equal arm balance

294: Objects for mass activity

295: Informal measuring units for mass activity

296:

297: **Evaluation:**

298: Measurement: Time: o'clock:

299: This was easy. I feel I may be missing something here, in terms of challenging the children's thinking. I need to look at resources for backup next time.

300: The textbook was also simple, we did the half-hour too, discussing ‘half’ in terms of fractions and fractions of the o'clock.

301: Addition and Subtraction:

302: The different forms of subtraction were difficult for many students.

303: Subtraction pages were tedious, especially webs.

304: The different terms for subtraction were given in word problems. Some children seemed okay with it, the biggest difficulty being when a small number was mentioned first e.g. the difference between 8 and 13 led to 8 - 13 = 5. We did some of these types of problems together as a whole group before doing them on the text page.

305: I did not do Mass 5 and 6 as the use of the equal arm balance was one of the better understood concepts in our assessment. We did the relationship between addition and subtraction instead, using symbol and numeral cards. The children had to model four number sentences using the numbers [2, 3, 5][3, 4, 7] and one set of Unifíx cubes in the centre. Early finishers also did [4, 5, 9]. I think their learning increased through this and my modelling the solutions using Unifíx cubes. We talked about ‘adding’ Unifíx cubes and ‘taking away’ Unifíx cubes and one child said it was ‘back the front’.

306: Addition 5 (p. 77): video-taped.

307: We did a speed test on the facts of 10. This went okay.

308: We did the text page first, we did it together for literacy reasons. The grid in the textbook caused a few difficulties in understanding what to do. Early finishers did 100s charts puzzles so nearly everyone had time to complete the text page.

309: We did non-routine problems as a whole class (e.g. I have 10 balls at home. I bought them on two shopping trips. How many did I buy on each trip?). Four answers were written up on the whiteboard, I modelled what to do, with assistance from the children.

310: In pairs the children went on to answer "There are 19 children in my class. How many are boys and how many are girls?" Today there were no puzzled looks or questions about what I wanted in this non-routine question, which is a step forward in the children's expectations in mathematics.

311: I told the class before going into pairs about the required ‘pair’ behaviour:

312: 1. sharing

313: 2. listening

314: 3. agreeing

315: 4. and later, listening to other people explain their solution.

316: The children used Unifíx cubes to complete the problem, and each pair came up with at least two solutions.

317: I put a table in front of the room and children came out in pairs to explain to the class their solutions, using the Unifíx cubes. The class was asked to evaluate whether the solution was valid. Someone was asked to come out and tell us how they worked this out "so quickly" and they shared their strategies. E.g. near doubles 10 + 9, counting on with fingers 14 + 5.

318: This went quite well but I had to be very firm with the group. A lot of children thought listening to the others was an opportunity to finish off their own solutions or play.

319: I feel there was, however, an improvement in this and I will do a lot more of it next term.

320:

321: **Evaluation of Term 2:**

322: Open-ended questions and investigations were used regularly this term, but not all of the time.

323: Pair work is going quite well though a few students have problems working together.

324: Sharing answers with the class has improved, but needs more experiences and a lot of structure, firmly enforced.

325: I need to allow more time for tying things together; sharing answers; justifying solutions; sharing strategies. This will be my next focus for Term 3.

Year 2 Mathematics Program, Term 3, 2002

Note: All names except those of my family are pseudonyms.

1: **YEAR 2 MATHEMATICS**

2: **Outcomes for Term 3** - taken from *Mathematics K-6: Outcomes and indicators* (Board of Studies NSW, 1998) in relation to *Mathematics K-6* (NSW Department of School Education, 1989).

3:

4: **Working Mathematically**:

5: WM 1.2: *Answers mathematical questions using objects, pictures, imagery, actions or trial-and-error.*

6: WM 1.3: *Explains simple mathematical situations using everyday language, actions, materials and drawing.*

7: WM 1.4: *Supports answers to mathematical questions by explaining or demonstrating how the answer was obtained.*

8: WM 1.5: *Recognises what worked and what did not work while answering mathematical questions.*

9: WM 1.6: *Uses the available technology to explore basic mathematical concepts.*

10:

11: **Number:**

12: N 1.2: *Describes and models the relationships between the parts and whole.*

13: N 1.3(b): *Uses a range of strategies to recall addition and subtraction facts up to 20.*

14: N 1.4(a): *Generates and describes number patterns using a variety of strategies.*

15: N 1.4(b): *Models numbers and number relationships in a variety of ways, and uses them in solving number problems.*

16: **Space:**

17: S 1.1: *Describes three-dimensional objects using everyday language, models and sorts them, and recognises them in drawings and pictures.*

18: S 1.4: *Represents the position of objects using models and sketches, and uses everyday language to describe their position.*

19: S 2.1: *Identifies, compares, classifies and constructs three-dimensional objects and represents them in drawings.*

20: S 2.2(a): *Demonstrates in practical situations that an angle is an amount of rotation and describes and compares angles using everyday language.*

21:

22: **Measurement:**

23: M 1.1(a)*: Recognises what features of an object can be measured.*

24: M 1.1(b): *Responds to and uses everyday comparative language relating to mass when recording and communicating measurements.*

25: M 1.2(a): *Estimates, compares, orders and measures the length of objects and the distances between objects using informal units.*

26: M 1.2(b): *Recognises the need for a standard unit of length and estimates and measures the length of objects to the nearest metre.*

27: M 1.3: *Estimates, compares and orders the areas of shapes using* informal units.

28: M 1.4: *Estimates, compares and orders the capacity of containers* using informal units.

29: M 1.5: *Estimates, compares, orders and measures the mass of objects using informal units.*

30: M 2.7: *Reads and records time in one minute intervals and makes comparisons between time units.*

31:

32:

33:

34: **TERM 3 PROGRAM**

35: Year 2 Mathematics groups

36:

37:

38: **Week 1**: S1.3; WM1.5

39: Basic facts investigation and/or basic fact practice every day.

40:

41: Signs of Progress 2A, 2B. Text pp. 78, 79.

42:

43: Revision of Term 1 and 2 work.

44: **Resources:**

45: Unifix cubes

46:

47: **Evaluation:**

48: Signs of Progress.

49: We had revision sheets in the textbook this week. Also, one day was missed due to a sports carnival. The revision pages were done with reading support and asking students for answers as we went. On the whole the class went okay but I'm not sure that tells me a lot about their understanding.

50: Space 2D5

51: This was not programmed (except it was part of revision) but we had some time so we did Symmetry. We used 'mira' mirrors and pattern blocks as well as drawing. The children enjoyed the activities, though in completing the final activity (where one partner drew a simple picture and the other partner copied it on the other side of a line of symmetry) showed that some children are still not understanding the mirroring concept.

52: Symmetry using 'miras' and pattern blocks, also drawing and using 'miras'. The activity to conclude, where one partner completed a drawing of the other using a line of symmetry gave good insight into children's understanding.

53:

54: **Week 2:** N1.4(b); M1.5; N1.3(b); WM1.4; WM1.5

55: Basic facts investigation and/or basic fact practice every day.

56: Number

57: Multiplication 3. Text pp. 82, 83.

58: A number sentence can be used to represent multiplication.

59: Open-ended activity for multiplication.

60: Using cards to make number sentences.

61: Open-ended activity:

62: “I bought 12 vegetable plants yesterday. I want to plant them next weekend. How many rows will I have to make and how many plants in each row?”

63:

64:

65: Measurement

66: Mass 5, 6, 7. Text pp. 74, 94 (Week 3).

67: Obtaining balance is important in measuring mass.

68: Units for measuring mass can be informal.

69: Differences in mass can be measured.

70: Use balance scales and a variety of objects to compare mass.

71: Compare masses using hefting.

72: **Resources:**

73: Equal arm balance

74: Variety of objects for informal units

75: Unifix cubes

76: Symbol and number cards

77:

78: **Evaluation:**

79: Multiplication 3:

80: Two text pages (82 and 83). We only had time for one hands-on activity. The text Page was done before the activity. Some students focused on the numerals and added them e.g. 1 group of 10 = 11. So I explicitly talked about multiplication sign not meaning the same as ‘+’ but is representing the ‘groups of’, ‘rows of’ and ‘lots of’. I talked about having 100 groups of 2 and explained that if we didn't use a multiplication sign it would be 2 + 2 + 2...2 + 2 (100 times). It was interesting that even though the pictures are there and they can count the objects, they miss the point when it comes to an algorithm. They need lots of experiences but there is not enough time.

81: Most children could get all combinations in the activity and wrote at least one number sentence using ‘multiplication sign’. A lot of children could also make a ‘+’ number sentence to represent the rows. However, a handful of students could not complete p. 82 without adding (as in addition) numerals in some examples e.g. 3 x 4 = 7.

82: The hands-on problem was "If I have 9 birds in 3 nests how many birds in each nest?" I realise this might have been better for division. This reflects my need for a deeper understanding or insight into the mathematics.

83: The children did this problem in a circle on the floor using Unifíx cubes. Most of the class were able to give at least one answer to this, though several children had difficulty using symbol cards to make a number sentence (they want to add the numerals e.g. 3 + 9 = 12).

84: Measurement:

85: We did Length 6 and 7 instead of Mass due to sharing resources with other teachers. The children enjoyed making measuring ribbons and using them to measure. Some had difficulty in measuring using 'longs' and discriminating e.g. 10 longs and 2 shorts were written as 102 longs. We talked about this.

86: While this went quite well, the pages in the textbook had too many activities.

87: Again allowing time for children to develop their own awareness for the necessity of a standard informal unit is just not possible. There is not the time in one hour, four days a week.

88:

89: **Week 3:** N1.4(a); WM1.2; M1.2(b); M1.2(a); M1.1(a); M1.2(b); WM1.6

90: Basic facts investigation and/or basic fact practice every day.

91:

92: Number

93: Numeration 11. Text p. 86.

94: The Hindu-Arabic numeration system is a base 10 system.

95: 100s chart games.

96: Bingo games.

97:

99: Length 6 & 7. Text pp. 81,85 (Week 2).

100: Informal units can be used to measure length.

101: The need for a standard unit arises from comparing lengths.

102: Informal measurement around the room and comparisons.

103:

104: Time 8 & 9. Text pp. 80, 91.

105: A day can be divided into hours.

106: The day can be divided into hours and half hours.

107: Digital and analog time.

108:

109: **Resources:**

110: Variety of objects as informal units

111: Variety of clocks

112: 100s charts

113: Bingo charts

114:

115: **Evaluation:**

116: One day was missed due to school photos during mathematics time.

117: Numeration 11: Text p. 86.

118: This page was difficult for a few children (a bit overwhelming), but on the whole it was understood. It did, however, take quite a long time. I would have liked to play a bingo game but there was not enough time.

119: The Text page was tedious for many, but only a handful of students had real difficulty completing the hundreds chart and associated activities.

120: Mass 5, 6, 7:

121: Completed in Week 3. The text pages had too many activities and the objects, specified in the pages, were not readily available. The activity was abbreviated and done in four groups. Some groups worked well together, some still have difficulty focusing on instructions and sharing activities.

122: Time 8 and 9:

123: Text pages: The hour Text page was done easily, the half-hour page saw a large group of children having problems. Some had problems with the minute hand (two or three children) but most with the hour hand (twelve to fifteen children) putting it before the hour, not after.

124:

125: **Week 4:** N1.3(b); WM1.4; WM1.5; S2.2(a);

126: Basic facts investigation and/or basic fact practice every day.

127: Number

128: Addition 5. Text pp. 89, 95.

129: Recall of addition facts is useful in everyday life.

130: Revise concept.

131: Open-ended activity to encourage mental addition strategies.

132: Open-ended activity:

133: Make up some different ways to add 5 and 8 in your head. How many ways can you do it?

134:

135: Space 2D9. Text p. 84.

136:

137: Lines can be used to represent shapes.

138: Draw and make with wool different types of lines.

139: Draw a picture with various types of lines.

140:

141: **Resources:**

142: Base 10 material

143: Unifix cubes

144: Wool

145: Pencils

146: Paper

147: Bingo cards

148:

149: **Evaluation:**

150: Number: Addition 5

151: The children found the text pages daunting and some children have difficulty seeing what they are doing is the same as the basic fact practice. Some children can verbalise their mental strategies, but a lot of them have difficulty thinking about thinking, but the activity was worthwhile. We reviewed mental strategies before completing p. 95 and this was helpful to most, but a few still struggled.

152: Space 2D9:

153: This was competently done by all students, they enjoyed making lines with wool and the majority did not want to stop making pictures using different lines. One child wasn't sure if a straight line was straight if it was at a 45 degree angle.

154:

155: **Week 5:** N1.3(b); N1.4(b); WM1.5; S1.1; S1.4; WM1.3; WM1.4; S2.1;

156: Basic facts investigation and/or basic fact practice every day.

157: Number

158: Subtraction 6. Text pp. 90, 100.

159: Recall of basic subtraction facts is useful in everyday life.

160: Introduce the number line by using the large one outside the kindergarten rooms.

161: Open-ended activity for subtraction.

162: Open-ended activity:

163: The difference between two numbers is 5. What are the two numbers?

164:

165: Space

166: Space 3D5 & 6. Text pp. 87, 92.

167: Natural and manufactured objects have shape and structure in three dimensions.

168:

169: Discuss and describe shapes.

170: Trace the sides of shapes to make nets.

171: **Resources:**

172: 3D objects

173: Unifix cubes

174:

175: **Evaluation:**

176: Number: Subtraction 6

177: We didn't use the number line outside Kindy but I made laminated number lines for each child. Children enjoyed using them and some children found it very useful and much quicker than using mental strategies for solving addition and subtraction problems.

178: The open-ended activity drew a variety of answers and we even looked at 100 and 10s, 1000 and 100s.

179: Space: 3D5 and 6:

180: I used the 3D shapes for the net activity. I would like all children to pull a box apart, but there are not enough boxes, so I have put off the second page of the text. I will approach the other teachers to ask if we can organise a box for each child. Then we will revisit this activity.

181:

182: **Week 6:** N1.4(b); WM1.2; WM1.4; WM1.5; M1.3; M1.1(a); M1.1(b)

183: Basic facts investigation and/or basic fact practice every day.

184:

185: Number

186: Division 1 & 2. Text pp. 101, 102.

187: Division involves equal sharing.

188: Division by grouping can be viewed as repeated subtraction.

189: Introduce the concept of sharing using lollies, pencils etc.

190: Have children get a specific number of counters and share with a number of children.

191: Open-ended activities.

192: Open-ended activities:

193: “I have 16 lollies. I want to share them with my friends. How many friends can I share them with so that all of us get a fair share?”

194: “Yesterday I put some counters into equal groups. I can’t remember how many were in each group, but I know I had 18 counters altogether. How many were in each group?”

195:

196: Measurement

197: Area 4 & 5. Text p. 61 (Already Done).

198: Informal units can be used to measure area.

199: Three or more areas can be ordered.

200:

201: **Resources:**

202: Unifix cubes

203: Objects for sharing

204: Counters

205: Objects for informal units

206:

207: **Evaluation:**

208: Number: Division 1 and 2:

209: Children have no problem with the concept of a ‘fair’ share. The open-ended activity produced all possible answers and children are not baulking at how to approach them any more.

210: We are spending quite a bit of time on basic facts investigations and going over mental strategies including: + 0; + 1; doubles; near doubles; locking the big number in your head; adding 10; adding 9 (some can see it); adding the last numbers e.g. 2 + 12 = 14; and drilling the one or two difficult ones.

211: Measurement: Area 4 and 5:

212: Group work rotating between six different activities using different units of measure. In the discussion, the idea of overlapping and measuring the bits left over were discussed, but not everyone has seen the relevance of this. We talked about the best units to measure different shapes.

213:

214: **Week 7:** N1.4(b); M2.7

215: Basic facts investigation and/or basic fact practice every day

216: Number

217: Multiplication 3. Text p. 93.

218: A number sentence can be used to represent multiplication.

219: Open-ended activity with the use of concrete materials and use symbol and number cards to make number sentences.

220: Open-ended activity:

221: “There are 4 flowers in each of my flowerpots. How many pots have I got and how many flowers altogether?”

222:

223: Measurement

224: Time 9. Text p. 96.

225: The day can be divided into hours and half hours.

226: Using clocks, practise making times with partners.

227: Play time bingo.

228:

229: **Resources:**

230: Numeral and symbol cards

231: Counting squares

232: Unifix cubes

233: Variety of clocks

234:

235: **Evaluation:**

236: Number: Multiplication 3:

237: Students completed open-ended activity in pairs. They are comfortable with this type of question now. They are still having trouble with number sentences for multiplication e.g. 1 x 4 = 5.

238: They are still having trouble with modelling number sentences rather than the problem. E.g. 2 x 4 flowers = 8 flowers, is represented as 2 flowers and 4 flowers = 8 flowers (whether this be drawings of objects e.g. flowers in a pot, pencils in a tin, or using Unifíx cubes). This can catch most of them out.

239: Measurement: Time 9:

240: We did a lot of practice with large clocks and this went well. The text page is pathetic in terms of Year 2 children's abilities to accurately mark the hour hand on a page. The pictures of the clocks are much too small. I will make a book with the clocks in it to give students more practice.

241: In responding to questions, asking for ‘half-hour’ answers, some students showed o'clock answers.

242:

243: **Week 8:** N1.3(b); N1.4(b); WM1.5; M1.4; M1.1(b); WM1.6

244: Basic facts investigation and/or basic fact practice every day.

245: Number

246: Subtraction 6. Text pp. 107,108.

247: Recall of basic subtraction facts is useful in everyday life.

248: Subtraction bingo.

249: Open-ended activity for subtraction with concrete materials and symbol and number cards.

250: Open-ended activity:

251: “Mrs Forrester went to her tool box to get some nails to hang up some pictures, but there were only 3 nails. How many did she think she had and what had happened to the other nails?”

252:

253: Measurement:

254: Volume 7: Text pp. 88, 106.

255: Capacities can be compared and ordered indirectly.

256: Demonstrate/discuss measuring volume.

257: Revise comparing volumes.

258: Use hands on equipment for students to complete text pages in small groups.

259:

260: **Resources:**

261: Unifix cubes

262: Bingo cards

263: Rice

264: Pasta

265: Containers

266: Numeral and symbol cards

267:

268: **Evaluation:**

269: Number: Subtraction 6:

270: Video-taped.

271: The text pages were a bit tedious for some children. Matisse twigged to the pattern, he could see the relationship between addition and subtraction. This gave me the opportunity to talk about patterns and mathematics being about patterns. Matisse called it a “trick” and we talked about patterns not tricks and “maths make sense”.

272: Measurement: Volume 7

273: Because of the nature of our workspace, in the library, and the need to use water, I did the ‘hands-on’ and we estimated and counted together.

Despite this, the children generally stayed on track and maintained attention.

274:

275: **Week 9:** N1.2; M1.2(b); M1.1(b); M1.1(a); WM1.5

276: Basic facts investigation and/or basic fact practice every day.

277:

278: Number

279: Fractions and Decimals 2 & 3. Text p. 103.

280: A group can be divided into a number of equal parts.

281: A group can be divided into parts and the parts related to the whole.

282: Using concrete materials to model fractions of a group.

283:

284: Measurement

285: Length 8. Text pp. 109, 110.

286: A formal unit for measuring length is the metre.

287: Introduce the metre.

288: Make 1 metre lengths for children to use in completing text pages.

289:

290: Space

291: 2D10

292: Angle is the amount of turning between two lines about a common point.

293: Find angles in the playground.

294: Make an angle maker.

295: Trace and draw angles.

296:

297: **Resources:**

298: Unifix cubes

299: Metre lengths

300: Numeral and symbol cards

301:

302: E**valuation:**

303: Number: Fractions and Decimals 2 and 3:

304: The text page was very easy for everyone. We used counters and paper squares to put '3 out of 5' on the paper etc. This went well.

305: Measurement: Lengths 8:

306: Children enjoyed this and worked well in groups, completing different tasks and comparing results. We discussed possible reasons for the differences we found e.g. different sized shoes for measuring.

307: Space: 2D10:

308: We never got to this.

309:

310: **Week 10:** S1.1; WM1.4;

311: Basic facts investigation and/or basic fact practice every day.

312: Space

313: Space 2D6. Text p. 111.

314: The shape of objects may be transformed as a result of actions on them.

315: Viewing shadows outside and on overhead projector.

316:

317: ASSESSMENT TASKS 3A and 3B

318: Text pp. 112, 113.

319: **Resources:**

320: Overhead projector

321: Objects for use on projector

322: Unifix cubes

323:

324: **Evaluation:**

325: Space 2D6:

326: This would have been good if we could have observed shadows throughout the day. This is difficult as I am there for such a short time, but the weather was overcast, which made it impossible to do any of this.

327: The concept was generally understood, although the direction of a shadow depending on the position of the sun was too abstract for many children to complete in their textbooks without more experience.

328:

329: **Evaluation of Term 3:**

330: The focus this term was on programming for a shorter activity time and using discussion as a regular closure activity. This didn't affect my program as such, the activities planned for were still the same, I just had to allow less time for them. I managed to do this most of the time and so didn't run out of time for discussion/closure. The quality of the discussion was varied and I still find it hard not to be the one who does most of the talking. This still happens a lot. I guess I am keen to make sure the focus of the lesson is clearly drawn out and this does not always happen via the children. I think I would need another lesson structure with less in it to really allow a culture of sharing insights and justifying solutions to develop. But I have made a start.

331: This term I really saw a development of investigating patterns in addition and subtraction facts in the children. We have developed a routine, they know what they are doing and do it quickly and efficiently now. They have come a long way in this.

332: As a class we have also come a long way in knowing expectations of behaviour, knowing what to do with non-routine questions and sharing our thinking. This has had benefits in timeliness as well as the obvious benefits.

333: I have tried to make a start on assessment for reporting to avoid the difficulties of last term. General assessment is also a difficulty (really knowing where the children are up to in their thinking). I need to focus on this next term.

Year 2 Mathematics Program, Term 4, 2002

Note: All names except those of my family are pseudonyms.

1: **YEAR 2 MATHEMATICS**

2: **Outcomes for Term 4** - taken from *Mathematics K-6: Outcomes and indicators* (Board of Studies NSW, 1998) in relation to *Mathematics K-6* (NSW Department of School Education, 1989).

3:

4: **Working Mathematically**:

5: WM 1.2: *Answers mathematical questions using objects, pictures, imagery, actions or trial-and-error.*

6: WM 1.6: *Uses the available technology to explore basic mathematical concepts.*

7: WM 2.6: *Uses available technology to help in the solution of mathematical problems.*

8:

9: **Number**:

10:

11: N 1.3(b): *Uses a range of strategies to recall addition and subtraction facts up to 20.*

12: N 1.4(b): *Models numbers and number relationships in a variety of ways, and uses them in solving number problems.*

13: N1.5: *Demonstrates an understanding of the monetary value of coins by using them in practical situations.*

14: N2.5: *Uses number skills involving whole number to solve problems.*

15:

16: **Space:**

17: S1.5: *Conducts simple data investigations and interprets the results using concrete materials with teacher guidance.*

18: S2.5: *Gathers, organises, displays and interprets data and presents findings using column graphs.*

19:

20: **Measurement:**

21: M 1.1(a): *Recognises what features of an object can be measured.*

22: M 1.1(b): *Responds to and uses everyday comparative language relating to mass when recording and communicating measurements.*

23: M 1.5: *Estimates, compares, orders and measures the mass of objects using informal units.*

24: M 2.4(b): *Compares and orders the volume of solids using informal units and displacement.*

25:

26:

27: **TERM 4 PROGRAM**

28: Year 2 Mathematics groups

29: **Week 1:** N1.4(b); WM1.2;

30: Basic facts investigation and/or basic facts practice every day.

31: Number:

32: Multiplication 3: Text pp. 114, 116.

33: A number sentence can be used to represent multiplication.

34: Revision of multiplication and the use of the multiplication sign.

35: **Resources:**

36: Unifix cubes

37:

38: **Evaluation:**

39: This was very text-based because of the number sentence focus. Some children had difficulty with the empty plates and counted the plates. When text pages were completed children used symbol cards and cubes to make their own sentences.

40:

41: **Week 2:** N1.4(b); WM1.2; N1.3(b)

42: Basic facts investigation and/or basic facts practice every day.

43: Number:

44: Division 2:

45: Division by grouping can be viewed as repeated subtraction.

46: Sharing objects between children. Text p. 120.

47: Equal and unequal shares. Text p. 123.

48:

49: Space:

50: Space 2D8

51: Shapes can be moved in certain ways to make symmetrical or asymmetrical patterns.

52: Flip and slide using pattern blocks and grid paper. Text p. 117.

53: Turn using pattern blocks and grid paper. Text p. 119.

54: **Resources:**

55: Pattern blocks

56: Grid paper

57: Unifix cubes

58:

59: **Evaluation:**

60: Division 2:

61: For the division unit the text pages were quite simple for most children and very little different to the work they have been doing on multiplication.

62: Space 2D8:

63: Children had very little trouble with slipping and sliding. Turning was fine in the text pages, but using grid paper made it difficult to turn some shapes around a point. I should have looked up content on these three concepts as I felt I didn't give the children an accurate understanding of the concepts.

64:

65: **Week 3:** N1.5; N2.5; WM1.2; M2.4(b); M1.1(a); M1.1(b)

66: Basic facts investigation and/or basic facts practice every day.

67:

68: Number:

69: Money 4:

70: Money can be used as a means of purchasing goods.

71: Use pretend money to make specified amounts using combinations of coins. Text p. 122.

72:

73: Measurement:

74: Volume 8:

75: Informal units can be used for measuring volume.

76: Use centicubes to make and draw models and compare the volume of the models. Text pp. 121, 127.

77:

78: Space:

79: Space 3D6:

80: Natural and manufactured objects have shape and structure in three dimensions.

81: Explore the cross-sections of a variety of foods.

82: Predict cross-sections of objects drawn in text based on experiences with the food. Text p. 97.

83:

84: **Resources:**

85: Play money

86: Centicubes

87: Paper

88: Appropriate food items

89: Plastic knives

90: Serviettes

91: Cutting surfaces

92:

93: **Evaluation:**

94: Money 4:

95: The money unit went quite well. Most students could add up several coins to make up a specified amount. Some students could use several combinations to get the same amount.

96: Volume 8:

97: The unit of work on volume in both text pages seems to have a strong focus on 2D representation of 3D figures (3D3). I pursued the volume focus - comparing volumes - giving an opportunity for the 2D representation of 3D without any explanation or demonstration of how to do this. All students could draw faces, many could give some representation of ‘3Dness’.

98: Space 3D6:

99: Children thoroughly enjoyed this - they predicted the shape of the cross-section well. However, some thought cross-section was, in fact, drawing the 3D shape rather than the face of the object (see drawing in program).

100:

101:

102: **Week 4:** WM2.6; WM1.6

103: Basic facts investigation and/or basic facts practice every day.

104: Number:

105: Calculators.

106: Introduction of specific keys, explorations and calculations using the calculator. Text pp. 118, 134.

107:

108: ASSESSMENT TASKS

109: Written test.

110: Speed test for addition and subtraction.

111:

112: **Resources:**

113: Calculators

114: Tests

115:

116: **Evaluation:**

117: Calculators - Subtraction 6

118: I have been unable to locate the calculators. We did Subtraction 6 and worked on ‘maths making sense’ in regard to the transposition of numbers in addition. For example, 10+3=13 is the same as 3+10=13. But this does not work in subtraction, for example, 10-3=7 is not the same as 3-10=7 or

119: 13

120: -7

121: 14 (this came out of the test).

122: We ended up briefly touching on negative numbers as several children mentioned minus seven.

123: Written test:

124: Grid paper was used in the exam and was very restricting in the concept of turning (rotating around a point). The exam question may be better if the grid paper was larger (see drawing in program).

125:

126: **Week 5:** N1.4(b); N1.3(b); WM1.2; M1.5; M1.1(b); WM1.4; WM1.6; S1.5; S2.5; WM1.6

127: Basic facts investigation and/or basic facts practice every day.

128: Number:

129: Subtraction 6:

130: Recall of basic subtraction facts is useful in everyday life.

131: Revise the use of the number line. Text p. 124.

132:

133: Measurement:

134: Mass 6:

135: Units for measuring mass can be informal.

136: Use balance scales and objects to compare and record comparisons of mass. Text pp. 115, 144.

137:

138: **Resources:**

139: Objects for weighing

140: Equal arm balances

141:

142: **Evaluation:**

143: Subtraction 6:

144: The focus of this lesson was more on subtraction generally and students used Unifix cubes to manipulate numbers as well as the number line.

145: Mass 6:

146: I could only locate two working scales on the day. We used them as a whole class together, which was not ideal. Day 2 we had five scales and students rotated to use a variety of objects for direct comparison and indirect comparison using shorts and Unifix cubes. Generally well done, and group work was very good; most children were involved and contributing and only a little bickering and not sharing was experienced.

Interestingly, students went to use informal units to compare three objects rather than direct comparison. We did both.

147:

148: **Week 6:** N1.4(b); M1.4; WM1:2; WM1:5

149: Basic facts investigation and/or basic facts practice every day.

150: Number:

151: Multiplication 3. Text p. 128.

152: A number sentence can be used to represent multiplication.

153: Open-ended question: I have three plates of biscuits. Each plate has the same number of biscuits on it. How many biscuits on each plate? How many biscuits altogether? How could we write this?

154: Draw groups of objects on the board and have students draw the equation to match.

155: Division 1, 2. Text p. 132.

156: Division involves equal sharing.

157: Division by grouping can be viewed as repeated subtraction.

158: Use counters to divide into groups.

159:

160: Volume 8, 9. Text p. 140.

161: Informal units can be used for measuring volume.

162: An object displaces its own volume when submerged in a liquid.

163: Read *"Mr Archimedes Bath*" (Allen, 1980) while playacting the events using objects and water and discuss concepts.

164: Use water to complete text pages.

165:

166: **Resources:**

167: Unifix cubes

168: Counters

169: *Mr Archimedes Bath* (Allen, 1980)

170: Bowl

171: Objects representing the characters in the story

172:

173: **Evaluation:**

174: Multiplication 3 and Division 1, 2:

175: Children went quite well at the activities using counters and Unifix cubes, but not as well in writing the equations. The open-ended question took a while for some students to work out.

176: Volume 8, 9:

177: "*Mr Archimedes' Bath*" (Allen, 1980) - we read this book. The children predicted what would happen and as a whole class we did a similar activity. I did the water manipulation, which was not ideal, but the children were very interested and involved. Some prediction and testing did not match and we talked about our results.

178:

179: **Week 7:** N1.4(b); M1.2(b); M1.3; WM1:5;

180: Basic facts investigation and/or basic facts practice every day.

181:

182: Number:

183: Fractions 1, 3. Text pp. 130, 131.

184: Fraction concepts are part of our everyday world.

185: A group can be divided into parts and the parts related to the whole.

186:

187: Revise on the board - writing of fractions and dividing into parts.

188: Use a group of objects to divide into parts.

189:

190: Measurement:

191: Length 8:

192: A formal unit for measuring length is the metre.

193: Revise the metre.

194: Hands on measurement using metre lengths.

195: Measure long distances using metre wheels.

196:

197: Area 5, 6. Text pp. 126, 137.

198: Three or more areas can be ordered.

199: The need for a standard unit arises from comparing areas.

200: Revise area using concrete materials.

201:

202:

203: **Resources:**

204: Metre rulers

205: Metre wheels

206:

207: **Evaluation:**

208: Fractions 1, 3:

209: Students generally understood the concept of 1 out of 4.

210: Length 8:

211: We used wheels. The children predicted and measured several things including the distance to the canteen (predictions were way out - they were much smaller) - this was a good experience measuring big lengths.

212:

213: **Week 8:** N1.4(b); WM1:2;

214: Basic facts investigation and/or basic facts practice every day.

215:

216: Number:

217: Addition 5. Text pp. 136, 139.

218: Recall of addition facts is useful in everyday life.

219: Examine adding 2 digits to reach a total.

220:

221: Space:

222: Space 2D 8 and 9. Text pp. 133, 135.

223: Shapes can be used in certain ways to make symmetrical or asymmetrical patterns.

224: Lines can be used to represent shapes.

225: Draw/discuss tessellations.

226: Make tessellating patterns using pattern blocks.

227:

228: **Resources:**

229: Pattern blocks

230:

231: **Evaluation:**

232: Addition 5:

233: 2 digit addition - many students struggled with this, more experiences need to be provided.

234: Space 2D 8 and 9:

235: The children made drawings of tessellations and discussed them. The children made a tessellating pattern using pattern blocks, they had great fun. Many children had trouble understanding the concept of being repeatable in all directions, but they understood that they needed no gaps. In the textbook it was a different matter. Continuing a pattern by drawing was difficult for many (most).

236:

237: **Evaluation of Term 4:**

238: My focus this term was on being more efficient in assessment and trying to monitor children more as they worked and making anecdotal notes. I know that my assessment for reporting was more efficient, I didn't spend as much extra time on it as I did in Term 2 but I still spent a considerable amount of time in RFF and withdrawing children from a regular lesson, assessing in mathematics time while others went on with other activities. I find it really difficult to do, especially assessing specific outcomes that require watching a child complete a task and questioning him about what he found/did. I don't know how to do it as part of the regular routine. But I'm not alone - both the other Year 2 teachers did the same in all KLAs. Maybe there is a problem in the detail required in reporting. No doubt I will improve with practice but I think this one is a very long journey.

239:

240: The end of term with a different mathematics class was a bit of a challenge, and it made me realise how effective and established my routines had been with my previous class. This obviously takes time to establish with every new class, but it wasn't so obvious to me before this. These routines can be as varied as behaviour management, classroom structure, lesson structure, moving from one activity to another, what we do in basic facts investigations and non-routine problem solving. They all impact on the quality and efficacy of a lesson.

Year 2 Mathematics Diary, Term 1, 2002

Note: All names except those of my family are pseudonyms.

Key: To roles in the school

Gabriel = Principal.

Robin = Stage 1 Coordinator.

Sidney = Year 1 teacher.

Bobbie = Year 2 teacher.

Mel = Year 2 teacher.

1: 3.2.02

2: My goals as a Year 2 primary mathematics teacher:

3: To provide learning experiences which stimulate all students to develop mathematical thinking, concepts and skills which they can utilise in real life situations and build on solidly for the future.

4: To form positive relationships with my students where they enjoy me coming to their classroom.

5: To encourage positive attitudes to mathematics in my students.

6:

7: How do I envisage teaching mathematics? - long term:

8: By providing non-routine problems to stimulate student thinking and encouraging students to work out their own ways of solving and sharing these different ways.*

9: Encourage a way of doing mathematics which does not focus on right/wrong solutions but focuses instead on thinking, problem solving, testing, rethinking, explaining, justifying.*

10: Using praise for social behaviour rather than mathematical activity. Instead I want to ask stimulating questions, probing questions to scaffold further thinking and, therefore, learning.*

11: Establish my role in the class as the facilitator of mathematics learning but not the judge of right and wrong answers and procedures while maintaining a respectful learning environment to self and students.*

12: Effective group work.*

13:

14: I'm going to find this difficult and will have to work at this for a long time - I'm envisaging taking this a step at a time and may focus on this in my personal action research.

15:

16: [*Looking at these I feel I'm going to find it difficult to do all of these. They are different to everything I have experienced in the classroom as a student and teacher].

17:

18: How am I going to start?

19:

20: My priorities this week:

21:

22: 1.Establish my position as the teacher in terms of behaviour management.

23:

24: While I have other 'bonus' goals this week I have to say this is my main focus and the one I feel most fearful of failing in, as it has long term consequences.

25:

26: How?

27: 1. I have already thought through positive and negative reinforcement using a smile and frown on the board and stickers. I look to give lots of positive consequences for appropriate positive behaviours.

28: 2. A variety of activities which are highly structured but enjoyable. I'm not going to start group work but might have a section of each lesson focusing on group work as of Day 2? Or Week 2? I'll decide after Day 1.

29:

30: Givens

31:

32: I am teaching the middle group of 22 in a cohort of 56 normally divided into two un-streamed classes of 28. They are divided into 3 groups by ability (school policy to enable gifted students to advance in either mathematics or English which are held at the same time across the Infants/Primary school).

33: Grouping: 22 top

34: 22 middle - me

35: 12 lower

36:

37: The school uses a textbook and a mentals book as well as a speed test book (photocopied from a resource book).

38:

39: Therefore:

40:

41: I am concerned that I need to cover the same material as the other two classes and I want to pursue a ‘problem solving’ approach to mathematics education. I need to establish myself as competent and acceptable in the school, so to a large degree I need to ‘fit in’. I have decided to take it slowly, start within the framework that exists in terms of the program and format that appears to be the norm and my own experiences and identify areas to focus on in terms of my own teaching which may affect lesson format, interactions etc.

42:

43: Programming:

44: First lesson:

45: I want to establish relationships and start to know names.

46: I want to have plenty to do to fill in the time.

47: I want to have resources and room ready.

48: I want no discipline issues - rules established.

49: My lesson has been determined by agreed general program which focuses on a page of textbook nearly every day (not in order) associated with a unit of the Syllabus (and Outcomes WM outcome) and use of a speed test for basic facts each day (publication?). We also have a mentals book - I need to look at how this is used.

50: I will use the topic from the text as a basis for Addition 3 and use the Syllabus activities as a basis for my lesson.

51: I intend to use whole class, pair work, possibly group and individual work (text, speed tests) - but not day 1 (group work).

52:

53: Programming notes for 1st week (having taught Day 1).

54: I want to incorporate addition dice game into this lesson as we missed it yesterday. So I will have 3 groups going 1. dice game 2. money game 3. text page.

55:

56: The speed test took too long yesterday but I will leave it for a while before changing format until the children know the procedure.

57:

58: I need to be firm in administering behaviour rules. There are a handful (3-5) of children who appear to have difficulty staying on task.

59:

60: I will try to program a day at a week this week to be able to make adjustments tomorrow in planning based on what happened today.

61:

62: For Day 3

63: One half - of wholes or groups (I need to focus on both).

64:

65: I want it to be ‘real life’ - so use food (sultanas, orange, fruit bar, popcorn).

66:

67: Textbook is very limited - it has everything ‘cut-up’ and students just need to colour in a half - I want them to ‘cut-up’ too - Other teachers’ resources also did this.

68:

69: For Day 4

70: Take away and comparison subtraction activities - provide for both - the textbook does.

71:

72: Subtraction - I want a record of student thinking today about subtraction. While we will do several activities e.g. dice game, counters and paper and word problems I will ask them to write down how they got their answer to the word problem (comparison subtraction).

73:

74: I need to organise a mathematics diary.

75:

76: 8.2.02

77: I sat down to program the rest of the term based on the program from last year which is the content/Syllabus connection basis for the whole Year 2 program.

78:

79: Because of resource difficulties (lack of and location) I have decided to program for resources and locate the resources for the following week on Thursday afternoons.

80:

81: I don't feel at this stage that I have a ‘big picture’ feel for the program but rather just a ‘bitsy’ approach because I am approaching it as described. I hope in programming I will get a more ‘overall’ feeling of the program and this might help me to focus on the ‘big’ ideas and still cover content.

82:

83: I am covering the units specified + text pages + speed test each day but looking at the syllabus to locate ‘main idea’ and appropriate activities.

84:

85: I am also looking at outcomes which are the basis for student assessment for reports and keeping those in mind when programming.

86:

87: 12.2.02

88: Some thoughts:

89: I don’t know if I can provide non-routine problems of quality to my class. I am concerned with ‘getting through’ the content and I’m fearful of not ‘getting through’ if I don’t clearly cover it all. I think I’m going to have to look at this approach later and focus on providing quality activities which provide for content coverage and are not set ‘textbook’ answers. E.g. the shapes I made. I wish there were resources for non-routine problems other than just ‘problem solving’ lessons. Maybe there are and I don’t know about them. A list of problems for each area of the Syllabus would be helpful.

90: We just don't have time, currently for much worthwhile discussion - it's more question and answers. Students seem to find it hard to focus on other students' work - many tend to continue to work on their own. I need to make time for quality discussion.

91: I am providing lots of 'hands-on' experiences, but they are not opportunities to solve non-routine problems using manipulatives but rather exploratory of the features of the manipulatives (e.g. Shorts and longs) or answering routine questions. I did provide paddle pop sticks (about 50 between 2) and asked them to check if there were 50 and to prove it to the class. I feel like this could have been done with several problems, over several days, with different materials. Only 3 pairs (out of 11 pairs) grouped paddle pop sticks: Two pairs into 2 groups (1 of 25 and 1 of 24) and the other into groups of 6 (8 of them).

92:

93: I gathered the class together to look at this and someone remembered how 10 was a good number to group (from Year 1) and made it easier to count, but I would have liked more students to 'discover' this over several lessons but was fearful of not covering content.

94: How do I provide time for quality discussion with Year 2 when they are so focussed on their own work or playing with manipulatives (not necessarily for the purposes of the lesson)? I will come back to this later. I think now I will have short times of discussion and sharing answers where appropriate.

95: I need to be focussed on student thinking for lesson planning. How do I do this with a set program? How do I make adjustments? How do I find time to spend time observing all students? Discussion? Is this an answer? Students" mathematics diaries? The first entry was fairly successful. I'll come back to this later.

96:

97: 28.2.02

98: I have been operating in survival mode this past few weeks (even months) due to several things:

99: 1. Ill health and an inability to do more than the ‘basics’ in my life, very tired.

100: 2. Daughter’s health issues and the anxiety associated with not knowing the extent of her problems, as well as anxiety associated with tests and results over several months and still not knowing.

101: 3. A lot of change in my family life:

102: a. moving

103: b. husband, son, daughter all doing new jobs

104: c. me working in a new workplace

105:

106: 4. Adjusting to a new routine trying to establish a routine

107:

108: Therefore, I feel my main focus has been to ‘fit in’ with the program of the school and build relationships with the other two staff members on Year 2 and my Stage coordinator. I feel that my circumstances (teaching only mathematics) gives me similar experiences to other novice teachers in relationship to the mathematics but gives me more time (should I choose to direct it) than other full-time teachers, but less local access to resources, staff communications and school life, than full-time teachers in a permanent position (or even casual block) within a school. I have different restraints than a casual teacher on a day to day basis. I am teaching my own (sort of) program and I have prior knowledge of what I am going to teach so I can either locate, make or substitute resources.

109:

110: 22.3.02.

111: Things have been ‘ticking over’ - I am settling into a routine and I believe I have a good relationship to both Year 2 teachers and my Stage Coordinator (though I seldom see her to talk to). I have been having regular discussions with them about three things:

112: 1. Students and learning or behaviour.

113: 2. Lesson content of past or future lessons.

114: 3. Resources, their availability and/or location.

115:

116: I have found discipline tedious as I don't have a normal full-time program and hence my follow-up for misbehaviour has to be either referred to the class teacher or I have to stay or come back for lunch-time to supervise 'detention'. This has happened twice so far and I find my plans for university work are in the back of my mind when I discipline, as I can be the one being 'punished'.

117:

118: Two children are the most troublesome in the class in terms of disruptive behaviour. One has been diagnosed with ADHD and is medicated. It is very strange but sometimes he acts as if he has taken a placebo, he is so uncontrolled in his disruptive talk and behaviour and yet other days he is the best behaved child in the class.

119:

120: The other child has had no investigation of possible ADD and speaking to his class teacher he appears to be easily distracted in her class but is one of many - she has a very difficult class in this regard this year. I stayed back with him on a lunchtime detention and had a very serious talk to him and this seemed to go well. I observed his behaviour working by himself and he was capable of working for a long stretch. His behaviour since has been greatly improved.

121:

122: I am upset with myself about my mathematics teaching this week. We did 3D3 investigating the properties of 3D objects. My activities had been worthwhile and I concentrated on productive group-work and listening to others when students explain their work. I spent a considerable time talking about acceptable behaviours and we discussed the reasons we need to use materials sensibly, cooperate with each other in the group, complete the set task, keep noise at a reasonable level and listen to others' explanations. I reinforced these behaviours with the promise of a special sticker for each group member of the 'best' group in terms of these behaviours. Generally the session went well, and students explored, categorised, explained their activities quite well for a first real group activity.

123:

124: However, that day I was told by another Year 2 teacher that the other two classes were using a cube net to make a cube the next day and would I like her to get enough photocopied for my group. I agreed, but was taken aback by its use in connection with 3D3. I didn't say anything but looked up the syllabus to check if I thought it would fit. I didn't and noted that the language 'cube' would not surface until 3D7. Looking again now I see it was an activity associated with 3D9 (nets). 3D9 is Stage 2 and not at entry level either. Yet I did it with my class. I regretted it immediately because of the difficulty of the physical task - it was just too difficult for nearly all the children except two or three and so the whole half an hour was spent helping students to stick the sides together (we had some Year 6 help arranged by another teacher). The students chose to decorate it (some as dice) and generally the children were happy to have it to take home though I had tears from one child because he couldn't get his to stick together.

125:

126: The other two classes spent considerably longer on the activity, the more able group spending the time decorating it and their teacher put it together. I am at a loss to understand why. I subtly suggested this activity was beyond Space 3D3, but was assured that it was beneficial because of seeing the 2D become 3D (and one child had commented that if he squashed his cube it would be 2D again). Yes I can see merit in that. The other Year 2 teacher explained that the drawing activity in the textbook was difficult for her group where students had to draw an object that fitted into different categories e.g. pointed end, straight edges, flat, rounded. She said she was very directed with this telling her group how to draw a 3D object e.g. draw a circle, draw another circle, now draw a line between the two at the top and bottom. This gave me a different insight into her expectations of her children in regard to the Syllabus unit. She seems to be expecting the children to make 2D representations which clearly evidenced the 3D. I had not thought of this. I was expecting students to recognise 3D objects with these characteristics (e.g. rounded, pointed), to be able to categorise them, but accepted any drawing of an object which fitted within the category regardless of its '3D'ness e.g. a 2D house not 3D (see diary for diagram if necessary).

127:

128: Anyway, I was upset with myself for giving the cube activity, as I don't feel it was appropriate to my class's fine motor skills and it certainly was beyond 3D3. I have tried to analyse why I did it when I was not comfortable with it and I have concluded it was because I want to 'fit in' with the other classes. I don't want my children to feel that they missed out and I was not confident enough in my own understanding of the syllabus. The Year 2 classes completed the same activity last year (I was told) with the Stage Coordinator as one of the teachers. One teacher I currently teach with has about 9-10 years experience, and the other has one year of experience, the Stage Coordinator probably has 15-20 years experience. I felt intimidated by their experience (not them) and worried about doing the wrong thing for my children and fitting in to the other teachers' expectations.

129:

130: 25.3.02.

131: We did Addition 4 today but I concentrated on number facts rather than addition problems because:

132: 1. I have been uneasy about the speed test the students are doing every day. We are now up to facts up to 13, but many students are not comfortable with facts up to 10.

133: 2. I have not seen a measurable improvement in many students and have a range of some students completing 6 questions and another the whole 50 in 3 minutes.

134:

135: So I am considering how to address this. I think I need to revise addition facts to 10, and I need to familiarise the students with patterns via exploration of facts. I don't know how to do this within the time frame but am thinking of doing this for the first 10 minutes rather than the speed test for a while.

136:

137: Secondly, I think I need to provide a range of tests (facts to 5, to 10 and slowly increasing through the teens) following these investigations, and trying to get the slower students more competent on facts to 10 to be able to build upon them. I hope to do this by getting all to ‘see’ the patterns, doubles, doubles + or - 1, +0, +1 etc. locking the big number in first and adding the small number based on commutative law of addition. Is this the way to go? I feel nervous about abandoning the speed test because of the other classes doing them - I might run this past someone. It’s awful to feel so lacking in confidence that you don’t trust your own judgement.

138:

139: 11.4.02

140: I tried to video lesson today but could not get the equipment, video or audio working.

141:

142: 12.4.02

143: I received approval from my principal for continuing this year and now will get paid as of Term 2.

144:

145: 15.4.02

146: At the end of Term 1 I have a few general reflections.

147: 1. I feel textbook driven and I don’t know how to deal with this. The textbook is imposed by the school and nearly every day a page is assigned. Some weeks there were five [pages] assigned for four days (Week 11). A sign of the importance of this was given by another Year 2 teacher (her 2nd year out) who said “I’m going to have to leave out p.?, the children just won’t be able to do it this year.” The program is so tight that there is nearly nowhere to ‘make-up’ a missed page.

148: 2. We did signs of progress (2 pages in text) this week. I did them instead of the speed test. There were questions in the book which children could answer correctly without grasping the concepts involved. I felt that this was largely a waste of time. I had to read them out carefully to avoid making children with literacy problems having referred mathematics problems. Did this mask students' results?

149:

150: I discussed this issue with a visiting mathematics education expert and she suggested compacting the pages of the text into two days and using the other two days for concept development through non-routine problem solving. She gave me the names of some resource web-sites and I'm going to investigate this further before I program for Term 2. The other major problem I feel is my desire to promote a culture in my class that doesn't focus on right/wrong answers. However, the textbook and marking immediately undermines this. What do I do? I have to mark - is there another way to mark? Can I differentiate between problem solving sessions and the focus on textbook sessions?

151:

152: **Action Research Focus:**

153: I have identified the need to shift from a textbook focus. I have decided to introduce non-routine problems as a regular part of my lessons in Term 2 to address this problem.

Year 2 Mathematics Diary, Term 2, 2002

Note: All names except those of my family are pseudonyms.

1: 1.5.02

2: I video-taped my lesson today (check in program notes).

3:

4: 9.5.02

5: I have bought three resource books (see reference list) [and borrowed another from my university supervisor] - to help work out non-routine problems for a problem solving approach this term.

6:

7: 17.5.02

8: Parent/teacher interviews

9: I had two parents book interviews with me and a further two popped in to see me. They went well except for one mother who felt that her child was bored because the work was too easy for him and wanted extra homework. He is not bored because the work is too easy for him (in my opinion) but has told his mother that mathematics is easy. However, he struggles with mathematics at times and is often not finished when a lot of children have. In class discussions he sometimes looks puzzled. I don't have anything to do with setting homework (for mathematics the children have a mentals textbook) so suggested she either speak to the class teacher, go to an educational book store or give some timed basic facts practice as a challenge to improve. I don't think she was happy with my response. She thought her child was in the top mathematics group last year and was very good at mathematics. It came as a surprise that he was in the middle group and not performing in that group 'at the top'.

10:

11: 21.5.02

12: I had an interview with the Stage coordinator about a number of things:

13: Firstly parent/teacher interviews. She told me two parents had spoken to the other class teachers about mathematics. One child was having bad dreams which the mother associated with coming out to mathematics groups. The other [child] did not like mathematics group.

14: Marley - I have had trouble 'engaging' Marley in any class activities he is slow to respond to any classroom management directions (e.g. sitting on floor etc.), is easily distracted by 'playing' with the concrete materials rather than using them to explore the set problem. I mentioned to the supervisor an incident where he sat on the floor with a 'pained' look on his face, about half way through the lesson. I asked him if anything was wrong and he said he needed to go to the toilet urgently. I sent him off immediately but he had wet himself. I sent him up to the office for a change of clothes. I spoke to him later about needing to ask to go to the toilet - that I couldn't know if he didn't ask. I was concerned that some students might feel scared of asking as I have told them often that they need to go to the toilet at recess time (immediately prior to my lesson), but I have never refused anyone. Some lessons (most in fact) would have 10 children ask to go, this is very disruptive. This week I have reminded them as they lined up and over half the class need to go - frustrating!

15:

16: I think this might have been the beginning of the bad dreams for Marley. However, Monday and Tuesday of this week Marley was much more involved and responsive, not only behaviourally, but mathematically. I rewarded his behaviour.

17:

18: Reilly is the child of a teacher at the school and in Term 1 he was very disruptive in class. He spoke out aloud on things that had nothing to do with what we were talking about or doing. giggled incessantly, made irritating disruptive noises e.g. tapping with feet or an object or humming. At first I thought it was ADD, but I have changed my mind as time went on. He was the second of the two most difficult children in the room - the first being ADHD and having really difficult days and really good days (Jay). Jay left the school at the end of Term 1 (he moved interstate).

19:

20: Not being a regular class teacher I found it difficult to follow through on discipline with these two children and nothing seemed to make a difference. However, I finally came back at lunchtime and kept them both in, doing work they had missed out on due to their behaviours and having a very firm talk. Reilly changed almost overnight and many days reminded me how well he was behaving. This has continued. I think his 'unhappiness' with mathematics was the result of being 'in trouble' (face in the frown on the board) and this has settled completely. He seems quite happy this term. I don't think he copes with change very well and the children have several teachers come in for a variety of lessons and I am one of them.

21:

22: Secondly a day for my daughter's specialist appointment.

23:

24: Thirdly, the storeroom and the fact that I couldn't get my material out due to the placement of other things.

25:

26: In passing I mentioned to the teacher my frustration with the textbook, the amount of time it took. She told me that she sometimes left out questions or did some of them because of the quantity, but felt that students benefited from written work because this is the format they will see in the future - 'work' and 'testing'. I see this is valid but surely a black line master (BLM) book used where appropriate would satisfy this and I have to ask about making changes to the 'whole school' approach to mathematics if this is the future (in terms of compulsory textbook in every class).

27:

28: Following this conversation I spoke to Bobbie about textbooks school wide and she said when she started at the school last year (her first year out) she didn't want one but was told they used one from K-6 compulsorily. I am concerned about my future there if there is no way I could change this for my practice I don't feel I will be able to develop as a teacher in the way I want (i.e. best practice). I will bring this up, before I go into my second year of teaching, with the principal to see if black-line masters and a folder is a possibility.

29:

30: Because of the policy and my insecurities I have had some frustrating lessons where problem solving activities have been going well and productively but I have had to bring them to a close to ‘do the page’ because there is no other time to catch up. [When completing] one page I asked for those having difficulty with the page to come to the floor - I had 12 children of 24 and still there were those at the desks who should have come out. It was very stressful trying to help them complete the page with understanding (I think this might have been a whole page of multiplication facts or the like but I am not sure).

31:

32: Next issue - assessment

33: This is difficult because of the problem in only having them for an hour a day, four days a week. Other teachers are drawing out their students one at a time and assessing by an activity. In a sense this is testing whether it is ‘hands-on’ or not. I wish I had made more ‘anecdotal’ observations. However, these would be in lesson times when the topic may have been new or reinforced and is this assessing their long-term retention? Bobbie told me that we should be testing several days later for this but now I’m asking myself is this true? We have nineteen outcomes to report on, most of them activity based and not assessable by a pen and paper test. How do I assess twenty three children on nineteen activities to prepare a report? Ridiculous!!! How do I keep them happily occupied while doing this individual assessment and still teach to the program? I tried to set up groups to assess four outcomes in one lesson this week (the one without an assigned text page) and it was exhausting for me, and boring for them. I only got through one task and nearly another. What to do? I am going to have to write up an initial report based on notes and text page completion and test the others I can’t complete next week. I suspect I will spend a lot of extra time at school and withdrawing children from class.

34:

35: Also Bobbie seems to have a very rigid idea of assessing e.g. (edges, planes and corner) she feels they should be able to identify all of them on a 2D representation of a 3D object. I think the outcome is relating to the 3D object and does not include the necessity to be able to count every one precisely (e.g. 12 edges on a cube) but to be able to identify what these are. Is our reporting going to be fair, because of our different understandings?

36:

37: 23.5.02

38:

39: Term 2 Week 4: I handed in my program today - it is really a re-hash of the one handed to me in a different format. It is content based with a brief outline of some activities with no detail. I felt I could cover the content in any number of ways without it being reflected in the program. It has made me realise that a program can tell you little about the way someone teaches.

40:

41: I included the main idea from the syllabus for every unit - the outcomes come from the bottom of each assigned text page and are mentioned by initials for each lesson and 'spelled-out' in the front of the program.

42:

43: The main idea I found helpful when determining how to teach each lesson, because a couple of times early on, I did not have this written down (before program complete) and I felt on reflection that I had missed the point in my teaching.

44:

45: 28.5.02

46: I got my program back from my supervisor today with very positive remarks. It is amusing as it is basically her program in a different format (I have made no changes to the content, only to a few activities, and none to the order (e.g. symmetry - 'make symmetrical designs' I included using computers). She liked my daily evaluation column - it gave her "an idea of how things were going".

47:

48: 30.5.02

49: Supervisor's observation of lesson yesterday.

50: I was nervous being observed and particularly aware of student behaviour and management.

51: I had a problem before I began with Bobbie suggesting I should give Mel the 3D shapes for her class because we would be testing next week and it would be unfair to the assessment not to have some time between experience and testing. I was 'floored' by this as I had spoken to both of them (having found the 3D shapes, having been told there were none) and suggested that if Mel wanted them Thursday (on Tuesday) I would do something else and use them next week instead. I spoke to Mel who seemed OK about me using them but not 'warm'. I hope I haven't got a 'difficult' situation on my hands (following on from Mel having to use a high school small room three days this week due to her having the most able group) - this was very difficult for her because it is a long way away and the children had to be very quiet (when they were excited about the new room) due to the exams next door. I think they did mainly bookwork even though the topic was 3D shapes because Mel did not want to swap for another topic. She didn't want the shapes when in this room as the children would have been too excited. On Thursday she was back in her room so it would have been a good time to use the shapes but I had already planned the lesson for observation and was not prepared for a change at 10.55 a.m. when the lesson was to start in 5 minutes and I was being observed. Especially as I had offered to do it next week two days earlier, explaining I needed to know what I was doing in the observed lesson.

52: The observation went well with positive comments and a suggestion to be 'warmer' in my responses with my voice or smile. I felt this was due to the observation but will be more aware of this in the next weeks. Robin said I was task oriented (as a compliment) and I need to think about this because in my previous work I feel I had warmer relationships with the children (due to being there all day and doing lunch duties and joining in school activities). I need to build up my relationships with the children.

53: The lesson started with a speed test (facts to 8) [children completing as many as they could do in four minutes].

54: The lesson was using 3D shapes (5 in the text) in groups to compete text page on how many curved/flat surfaces, edges and corners, and passing the shapes from table to table. To finish we had a mystery bag with the shapes in it. It was very practical but not very creative. I was happy with it, it was safe.

55:

56: 31.5.02

57: End of Week 5 Term 2

58: I have had an emotionally difficult term trying to make changes in my approach e.g. non-routine problems, with some good results, but much frustration. I ‘hate’ using the textbook. As I have gained experience and feel confident about class control and being accepted at the school as competent, I am thoroughly frustrated by feeling ‘driven’ by the textbook. Every week at least three of the four days a page is required, some pages taking half an hour to complete (even then some children don’t finish). Children lose interest and get distracted by friends, some just day dream. Some find the amount of work on the page daunting and give up. A lot just have trouble understanding what to do, as some of the problem is ‘maths’ related, a lot is ‘reading’ related and some is just maturity in understanding directions and being able to follow them.

59:

60: 14.6.02

61: Reports were finalised this week. As I thought, I had a lot of assessing one-on-one to do and I came in extra time to do it. I guess class teachers can withdraw children from other lessons and in RFF. I found it all stressful and I only did mathematics. Writing up reports by hand seems crazy with computerised everything [else]. The last school I was at had reports on computers two years ago and it was a lot less resourced than this one. Rewriting errors is such a pain. Anyway it's all done now.

62:

63: We did symmetry using the computer drawing program, the children loved it, a pity there wasn't more time.

64:

65: 27.6.02

66: **End of Term 2, 2002** for me today.

67: The big job this term was assessment for reporting purposes and I have already stated some of the difficulties. Since then, however, I have had a few more.

68:

69: Bobbie designed a written test to assess several outcomes. She ran some past me based on last year's assessment test and I was disturbed by:

70: Money - outcome "identifies and states the value of Australian notes and coins"

71: - Photocopies of money in black and white were to be used and Bobbie wanted to remove numbers because it made the question too easy. I was surprised and pointed out the nature of the outcome and how we all identify money using numbers as well as other clues and that knowing the picture e.g. lyrebird was not a clue most people would use in identifying the value of a note. This appeared to me to be more related to other KLAs e.g. HSIE. She changed the test seeing my point but felt it was easy. This is true and so maybe the outcome was inappropriate.

72: 3D space

73: - Originally Bobbie suggested 2D pictures and children to count faces, edges, corners. Outcome "identifies edges, faces and corners of 3D shapes". On revised test: one picture of 3D shapes and three labels pointing to each feature (though not touching). Children got confused and performed badly even with clarification of where arrow pointed. Bobbie and Mel decided to keep the question on the number of faces, corners and edges using 2D representations. However, the cylinder looked like this to "sort the children out". I found this strange considering the outcome.

74: Area being measured by informal units

75: Outcome: "compares areas using informal units". Area was not to be covered until Week 6 and it was not to be compared using any units. The text page (61) was the comparison of bigger and littler shapes. Yet we still assessed for this. Surely the outcome needed to be changed. I planned to teach it Wednesday and assess Thursday by the test Bobbie had said would be ready for Thursday. But on Wednesday she handed me 24 copies. I said I would do it tomorrow as I was teaching Area today, but she said I had to do it today as all Year 2 had to do it at the same time. This is crazy. Are they going to cheat in the playground? Maybe sell their results? We did it - children did quite well with area because the question told them to use shorts. The correct answer, however, was possible to guess just by looking. I don't think it was a good assessment tool.

76: I had not covered calendars - I think it's a thing you do with your own class regularly.

77:

78: Anyway it is administered and using the results I determined to reassess 3D shapes using 3D shapes. The test was totally insufficient to cover all nineteen outcomes (it was designed to but a lot have to be assessed using 1:1 hands-on activities). So I went into school for two and a half days and tested children individually. While more reliable it was a once only experience and difficult to determine 'consistency' which was one of the grades for the outcomes ("achieves consistently").

79:

80: **I need to be better organised in Terms 3 and 4 planning for reporting and therefore assessing.

81:

82: I have found the assessing for reports very difficult and frustrating and tedious. However, I'm glad I did it. My classroom observations did not necessarily lead me to the same assessment of children's understanding as '1:1, hands on' did.

83:

84: **Action Research focus:**

85: I have struggled this term trying to use non-routine problems where possible while still completing text pages, assessing and doing reports.

86:

87: I have made some headway which was evidenced today in my video-taped lesson when no children 'baulked' at what I was asking of them having seen these non-routine or open-ended questions before.

88:

89: I have decided to continue focusing on 'non-routine' problems next term, but want to plan for a less 'packed' lesson making time for tying things together, sharing solutions and strategies. I have worked on 'pair work' and to a lesser degree 'group work' but have not made it my main focus for change.

90:

91: Interestingly, Bobbie asked me last week if I was returning to full-time teaching next year. I explained my project and she wanted to talk about how teaching mathematics in school was so different to what she had learnt to do at uni, I asked her what the differences were. Her immediate answer was "Textbooks!". Then she went on to talk about open-ended investigations at uni, sharing findings with each other and the class. She thought they were great. I asked why she felt she couldn't do the same at school and she responded that children couldn't cope with the group work. A senior teacher came into the room (Sidney) and Bobbie made the same comment to her. She agreed that uni taught quite differently. They agreed between them that group work was a problem, and that if you concentrated on establishing group work it could take all of Term 1 and you would teach no mathematics. I suggested a 'whole school' approach and they smiled but made no response.

92:

93: I want to take time in the holidays to look carefully at resources (books) for more ideas.

94:

95: Having complained about the restraints of the school I need to say they are supportive of me in lots of ways and also helpful.

Year 2 Mathematics Diary, Term 3, 2002

Note: All names except those of my family are pseudonyms.

1: 31.7.02

2: I am enjoying teaching mathematics and feel that despite difficulties (internal and external) that I am making headway in developing in areas that I have identified. But several things are happening which make me think that I might need to change from part-time teaching to full-time classroom teaching.

3: 1. My experiences, while similar to the experiences of other beginning teachers I am in touch with, are also very different in some ways. They are struggling with things that I am not experiencing teaching part-time.

4: 2. Comments such as those made by Bobbie and Sidney require me to teach full-time to investigate. To me it seems perfectly logical to approach the instigation of group work from a whole school perspective, especially when it is so strongly supported by research as essential for worthwhile learning. I know neither of them can instigate it from [a]'whole school' perspective [on their own], but if Sidney was doing it in Year 1 and Bobbie in Year 2 that's half the grades. There must be other things that stop them if they see the worth of it. I know it is hard to set up a class culture of group work, so too is the culture of [listening attentively and] justifying [our] answers to the class and verbalising mathematics thinking, I have found it hard in the restricted time I have, I think I need to get a more realistic perception by teaching full-time across all KLAs. I've spoken to my university supervisors and they think it is a good idea. I will ask Gabriel if it might be possible for 2003. I will put out feelers elsewhere too.

5:

6: 1.8.02

7: I spoke to Gabriel, she was positive but doesn't know if she'll have anything available, she'll get back to me.

8:

9: 7.8.02

10: This is the middle of Week 3 Term 3. I have finished my basic program for Term 3 (which is a rewrite of the one given to me by the school in my own style). I have spent hours every days doing speed tests to 20 on my computer - so time consuming but I didn't like the ones we used at school as they had other things in them and a format I wasn't always keen on.

11:

12: I have been focusing on leaving more time at the end of the lesson for drawing things together. This is working in terms of finishing on time and me focusing on anything that needs addressing specifically. But I haven't incorporated good discussion and sharing times where students really justify themselves. I suspect this takes a lot of time (more than I have in my program when I have to include a speed test, a text page and an activity). Discussion is brief and covers essentials.

13:

14: I read "*What's my problem?*" by Penny Skinner (1990), aimed at a problems solving approach to mathematics where students write their own problems. She has the whole session between recess and lunch for mathematics. How does this work in terms of fitting in every other KLA? How does she do it? I wonder if she still does it. The book was written in 1990.

15:

16: I was talking to the more experienced Year 2 teacher (Mel) this week and was a little disturbed by her comment about reminding herself that quick recall of basic facts will be more important than working things out when the children reach Year 8. I find teachers make a lot of excuses to justify the way they teach (myself included).

17:

18: Having completed my basic program I'm going to add 'non-routine' questions so I can keep them in mind as I evaluate my lessons.

19:

20: 19.8.02

21: Gabriel spoke to me today and offered me Mel's job next year (she's going on maternity leave). She couldn't tell me which Year I will be on but I asked her, if possible, could it be Stage 2 or 3 to give me a different experience in terms of content and children. She said she'll do her best.

22:

23: 21.8.02

24: The speed test booklets I made are working well. The first day on a new number (e.g. facts of 11) they do an investigation and then the following three days they do a related speed test (with previous facts also included). The investigations are going well. The children know what is expected of them now and they complete the investigation quickly. We write up their findings (I used to ask for facts, write them up, we'd sort them and discuss how we might remember them. Now they sort them by putting up the next fact in order). They are now doing a great job of verbalising why we don't have to remember both 7 + 4 = 11 and 4 + 7 = 11, we can lock the big number in our head, make tens, + 0, + 1, doubles or new doubles are easy. They have come a long way.

25:

26: Some of the number pages in the textbooks are very tedious, overwhelming in fact for some children. Only those who are very competent at adding (or subtracting), and work persistently cope well. For a large part of the class they are daunting. I feel open-ended questions would get them doing the operation without the tedium, and the tedium of marking them. It's funny, the majority [of the children] can complete basic facts speed tests without baulking, but presented like they are in the text (e.g. spider webs of 10 or more facts) is too much.

27:

28: 4.9.02

29: The introduction of the number line was a good lesson. I made laminated number lines and the children picked up how to use them [quickly].

30:

31: It was a shame I could not organise that everyone had a box to pull apart for 3D nets. This is one of the disadvantages of only teaching mathematics, otherwise I would have sent a note home with homework [for the children] to bring them in.

32:

33: Again in Time the textbook was not suitable for the age group, the fine motor skills of a Year 2 child are not developed sufficiently to enable them to draw hands on a 2 centimetre diameter clock with any accuracy. I have made some booklets with [large] clocks in to give to early finishers, and hopefully we will have time for everyone to use them.

34:

35: 21.9.02

36: We did Volume last week and I'm afraid I was not brave enough to let all the children use water and sand. For two reasons:

37: 1. The workspace is a carpeted library.

38: 2. The potential for chaos and mess is huge.

39: The lesson was okay without it.

40:

41: I have been trying to get more of a handle on assessment this term, noting improvements. when I see them, but this I find almost impossible to do while teaching, helping, maintaining behaviour management and all the other things that are happening. If I walk around with my assessment sheet I feel I'm not as available to help as I should be, this sort of multi-tasking is beyond me.

42:

43: 26.9.02

44: I have been asked by Gabriel to take over Mel's class when she goes on maternity leave next month. This will mean teaching half the grade for mathematics and so our current mathematics groups would change, but I feel that I have gotten to know the children quite well and this would be a good opportunity to get to know other staff and students better before starting full-time next year, so I've decided to take the opportunity.

45:

46: **Action Research Focus:**

47: The term finished for me today. I am quite happy with my progress in terms of focusing on student thinking, offering non-routine questions, trying to tie the lesson up with class discussion and utilising group work. I feel very constrained by the textbook, I don't always think it addresses the outcomes, it can be difficult for the children in terms of reading/fine motor skills/attention span. I would really like to have it as an option (Black Line Masters (BLM) of the pages to use those you want). However, I've had to think this through in terms of whether I go elsewhere next year (where the textbook is not compulsory). The two other schools I think might take me on also use mathematics textbooks, one I know compulsorily, the other I'm not sure. But I've reasoned that this is how it is at this school, the project is not only focused on my improving my mathematics teaching, but on what influences the way I (and others) teach. If I was teaching from a targeted position I might be in an identical situation. Other beginning teachers go into a school and have to teach in the existing conditions. So I have decided to stay here (I know I would have no success in asking for permission not to use a textbook - and I would have to be on staff for a long time before I could make a case for it and be listened to) and work within this as a constraint. I now have the advantage of not being totally new [as I enter my second year], knowing some of the students and staff and the layout and resources of the school.

Year 2 Mathematics Diary, Term 4, 2002

Note: All names except those of my family are pseudonyms.

1: 18.10.02

2: Started school again this week. I've used the program given to me, again, as a basis for programming and I am currently completing this (it is not due until Week 5). I am only programming mathematics and assessing mathematics despite teaching Mel's class from Week 6 onwards. Mel is doing the programming, assessing and reporting for her class (which I'm thankful for, there is no way I would be able to report on the other KLAs. Reports are due in Week 7).

3:

4: **Action Research Focus:**

5: I am trying to focus on assessing as I go into this term - I don't know how I'll go, I've found it so difficult to do in the course of a lesson, just too much happening and I have such a poor memory for who did what.

6:

7: 25.10.02

8: I noted in my program evaluation that I needed to look up the content of flipping, sliding and turning prior to the lesson (I just presumed I knew it). It was the rotating (turning) around a point which I wasn't sure of, and while the textbook question was fine, the grid paper programmed for it did not allow the shape to rotate around the point [without specifying where the point is]. I looked it up later [in the Syllabi and a mathematics dictionary] to clarify my own understanding for next time, as I don't think I was accurate in the way I presented it in the lesson (copy of the diagram in the diary).

9:

10: 1.11.02

11: Another problem with the textbook this week (or maybe it's the program). Volume 8 focus is "informal units can be used for measuring volume". The activity we did was to use centicubes to make models and compare the volumes by counting the centicubes, which was fine. The textbook, however, focused more on 2D representation of 3D figures.

12:

13: 8.11.02

14: We completed written tests this week. As I have noted in my program several students were transposing numbers in subtraction sentences e.g. 3 - 10 = 7 and 13

15: <u>-7</u>

16: <u>14</u>

17: I took the opportunity to follow up the test with a focus on “maths makes sense”, getting children to check and see if their solutions to subtraction questions make sense. This was worthwhile, But as I said something like "3 takeaway 10, I can't do that" two children said -7. This surprised me. So we talked about that and how they would be doing [mathematics with] negative numbers when they were older. Children come to school with so many varying experiences, as this showed. It was good to briefly talk about [it], and quite a few [children] laughed and were interested in what a negative number was. We did go over “maths makes sense” and asked the question "Does that make sense?" for each problem.

18:

19: The other thing that came out of the exam was the inadequacy of the grid paper provided on the page (for rotating around a point). The exam paper was basically the same as last years and shows a lack of understanding of around a point.

20:

21: Another assessment issue surfaced with a length task asking the children to measure the perimeter of a rectangle using shorts. I would have accepted a range of answers as satisfying this outcome (e.g. Placing the shorts on the line, inside the line or outside the line), but we were only able to accept one answer (placing them inside the line and not counting those on the corners) as this gave the ‘correct’ answer. I don’t think the outcome is assessing this level of accuracy (The outcome is “Measures perimeters using informal units”) but rather the ability to identify a perimeter and use an informal unit with no gaps or overlaps to measure it. I’m afraid I would probably have gotten the answer incorrect (my immediate reaction was to place the shorts on the inside of the line, this gave an answer of four less shorts unless you count the corner ones twice). Apparently the exam question last year showed a rectangular shape with rounded corners and they found they had to accept a variety of answers and so they changed it for this year so that there was only one correct answer. Perhaps another type of unit might have been used that did not require that sort of discrimination. I know Bobbie prepared her class for the question by showing them how to use shorts to measure it and explained why they must measure from the outside and not count the corner shorts, my class did not get that explanation, so I guess I disadvantaged them, though I know a lot of them probably wouldn't have seen the point anyway. I've tried to work out whether my approach is too lax, whether it's me that has missed the point, or the other teachers. I guess I will always think it's them unless someone can make a case for it (I guess the case for it would be "This is the only answer that is really right") that I agree with. I tried to figure out what it is that annoys me about this sort of difference and I think it is that it highlights a fundamental difference in approaching the teaching of mathematics. I am trying to let go of my natural disposition to focus on mathematics being right and wrong and concentrate on the process and I feel that this approach is reinforcing this notion that mathematics is about getting the right answer. I think that the textbook focus also supports this notion. Well that feels better, that's off my chest!

22:

23: 15.11.02

24: Today is my last day teaching this group of children. Next week I teach Mel's class full-time from her program. This week went well except for the difficulty locating resources. I have been trying to get a lot of the assessing for reports done but there is still a lot to do. I will have to pull children out of class in my RFF I think.

25:

26: We finished investigations of basic facts this week with the facts of 20. Now it will just be speed tests. The children have really improved, not just in their completion of speed tests but in their mental strategies for addition and subtraction, seeing patterns and talking about them.

27:

28: 22.11.02

29: I finished my first week on the full class today. It's been a bit of a struggle - Mel's program is a little hard to follow and there are about six children who are real handfuls - several I didn't have in my other class. So it has been like starting over with a new class, with children testing the boundaries, like they do with casuals. Scout and Sam in particular have required me to be very firm. Scout throws tantrums and Sam challenges me and questions everything, and [feels he] is always badly treated. (I had to prevent myself from laughing when Sloan (a very mild, shy child), in total frustration with Sam lashed out and hit him, when Sam wouldn't stop badgering and nagging him. That's exactly what I feel like doing. The hard part was having to discipline Sloan as well as Sam.

30:

31: Volume 8 and 9 - again I did the manipulation of the water (no wet area in the classroom and not enough equipment for everyone - and I must admit as they are a new group and there are so many children with behavioural problems, I did not want to risk chaos) - but it went quite well. I worked really hard to keep them interested and the noise level under control - very tiring. We sat in a circle on the floor, with me at the edge reading the story, asking for predictions and putting the next object in the water, not ideal but necessary.

32:

33: **Action Research Focus:**

34: I have had to assess students in mathematics lessons one-on-one while setting up work for the other students and I have had to withdraw children in my RFF. It has taken me a lot less ‘extra’ time [than second term] so I guess I have managed it more successfully but I still have a long way to go. I'm not the only one who had to withdraw children, Bobbie was doing it and Mel actually came in from her leave to do it. Poor thing, she had so much to do. She finished and went into labour - a baby boy! Anyway, reporting has finished - I had a few rewrites, but only a couple.

35:

36: 6.12.02

37: The last fortnight has revolved around swimming lessons. It takes over two hours each day, and falls at lunchtime - so we have to eat early and let the children play when we return. I am still having to focus on behaviour management - both Sam and Scout did not have me before and they are hard work. Scout had to stay back from swimming lessons one day this week due to his behaviour. He was devastated, he is a great swimmer and it was a big deal for him (He has ADHD and has learning difficulties, as well as behaviour problems, so it was lovely to see how successful he is in this). I was encouraged by Mel before she went on leave (and Bobbie) to follow through with this [if he was too difficult] and I got to the point where I had to. Scout doesn’t seem to respond to positive comments (he can’t control himself for long enough to have his name stay on the smile). The most effective incentive is the removal of negative consequences. He is exhausting.

38:

39: Mathematics is in home groups. Mathematics lessons aren't as well organised and prepared for as they have been all year - the full-time load has already affected that. I find I am looking for equipment on the morning rather than having it organised two days in advance. Number lessons have been focused on the textbook pages with the provision of manipulatives e.g. Unifíx cubes etc. I have provided some open-ended questions and found the students I have not taught before finding them unusual. I have noticed the difference teaching this class particularly in the Number strand, it is not familiar with the routines I have or the expectations regarding sharing solutions. and so we don’t seem to be as quick in changing from one activity to another, and the children are not as settled when we discuss answers. These are obviously things that develop over time and we haven’t got that time. The Length 8 lesson was very experiential and the children coped well with working outside - everyone had a turn of pushing the wheels (we had four) and keeping count.

40:

41: Tessellating patterns with blocks was very enjoyable - children love to play with them. But in the textbook it is hard to complete (fine motor skills) and gaps (e.g. between circles) could be shapes. This requires adult or more grown-up understanding. Just not very relevant.

42:

43: I haven't taped a lesson this term (so much to do with assessing) so I will tape Tuesday’s lesson. I don’t know how this will go - the children are difficult enough without the excitement of the last week of school and all the disruptions. I have not covered Area this week but would like to review two digit addition.

44:

45: Next week is based on Christmas activities booklet that has already been printed. The week seems to be full of assemblies, performances and end of school activities. Should be fun.

46:

47: 13.12.02

48: I broke my foot severely (several bones) last Saturday night on a church camp. I had to ring in sick and was unable to teach this week. This has been troublesome in that I had planned to tape my lesson on Tuesday and this could not happen (Postscript - this should not have happened anyway - I did not have permission forms for all the students in my current class - so it is a good thing I did not get to do it - should have given this thought earlier in the term but assessing got in the way). I am struggling to get anywhere.

49:

50: 21.12.02

51: **Action Research Plan:**

52:

53: So my first year of teaching primary school mathematics has finished. I have enjoyed it on the whole, despite the fact that I didn’t often teach in the way I would like to. I have decided to give myself a ranking out of 10 of where I feel my teaching now compares with the characteristics of best teaching practice.

54:

55: I have developed:

56: • useful behaviour management skills using both positive and negative reinforcement, but focusing on the positive, with Year 2 children (9).

57: • a safe risk taking environment where children feel safe to share their answers and thinking (8).

58: • my understanding of the content of Year 2 mathematics (9).

59: • my understanding of the possible ways Year 2 children will approach different aspects of mathematics and their mathematical thinking (6).

60: • a problem solving approach to enable Year 2 children to 'discover' the mathematics (6).

61: • a culture of 'talking about doing mathematics' in this Year 2 class (6).

62: • a culture of participating cooperatively in a group to solve problems and present your solutions to others (6).

63: • a culture where mathematics is not about getting 'right' answers but about the process of getting an answer (6).

64:

65:

66: **Postscript** (February 2006):

67: I have not included many details of other events in my life in this diary - teaching part-time meant that I could cope easily with my commitments on another school board, church, family and social commitments as well as the need to organise and attend doctor's appointments for my daughter's unfolding health problems without it requiring me to take time off. The possible seriousness of her condition became apparent in June 2002, with concerns for a diagnosis of an underlying cause for her problems beginning in December 2001. This did have an effect on my emotional state, but I felt able to cope without it affecting my teaching.

Video notes Year 2 – 1.5.02

1: **Note**: All names except those of my family are pseudonyms.

2: **Video notes Year 2 - 11.4.02 Term 1 Week 11**

3: **Focus:** Reflecting and identifying a problem for next term

4: Videoing today was not successful. We had difficulty getting the machine to work. We pretended it was working so the children would have the experience of getting used to having someone in the room filming them.

5:

6: Lesson Notes Year 2, 2002: 1.5.02

7: Focus: Introduction of non-routine problems.

8:

9: Students at desks. I am putting names on the board under the smile. I talk about video-taping and answer associated questions.

10:

11: I lead the class in visiting yesterday's work basic facts of 4.

12:

13: Each student has a bag of laminated squares they investigate the basic facts of 5 using squares (one side coloured and the other side white). They write down the associated number sentences.

14:

15: I say to a student "Let's see if you can see some patterns Zane". Some children want to show 'take-aways' - they are instructed by me to "show the patterns". "Show me that you know what the patterns are". "Well done, Zane". "What happens…?" I help a student and talk to another about the patterns.

16:

17: I instruct them to make a subtraction sentence starting with 5 (reinforcing 5 is not the answer). I help Charlie again with squares and number sentences. I encourage students with "Well done" and "Perfect". Students are working well, obviously thinking and writing. I continue to walk around and look at pupils' work when they bring it to me (correcting and clarifying). “if you have a problem put up your hand please, like Zane is…”

18:

19: Vic asks for help with subtraction sentences. Class noise increases. “Von you’re doing the wrong thing (talking and playing)… children put the money away (students playing with coins for the canteen)”. Joey shares something he is doing with me, but he is not on task so I say “That’s not what I want Joey…, take-aways that start with 5, [5] is not the answer”. I say "if you are at your desk you need to be doing your work because we are waiting for you." "Vic this is a warning, next time your name will go under my frown." I tell the pupils at their desks to finish up, I give them to the count of 20 to come to the floor, telling them it doesn't matter if they have finished their work. I tell them that I want to see everybody's mouth closed and their eyes looking at me.

20:

21: I ask them if they found the laminated squares helpful, and tell them that they can use them in their speed tests if they would like to.

22:

23: I explain the activity they are about to do with money and answer questions. I state that they will be given a number (1 or 2) and explain their roles. In the first part of the lesson 1 will be the seller, 2 will be the buyer. I go around the class giving each child a number. I bring their attention to me again by saying "eyes this way 1, 2, 3, Von I am waiting."

24:

25: Then I introduced the first problem. Number 1 is the shopkeeper, number 2 is buying apples, they are 70c. Number 2 has to pay number 1 with the coins and paper money on their desks. I walk to the second whiteboard and tick a child's name but say nothing. I say to the class "when you have worked out how you're going to pay, hold up your money in the air". Two students ask for help and I talk to them about what they need to do.

26:

27: To get the class’s attention I say "eyes this way 1, 2, 3, Von you are the last person again. Wallis I am putting your name under my smile." I then organised children to swap their roles. This time child number 1 is buying a fan for $110. I look around the room and ask questions or make comments like "you need three notes?", but I don't walk. Students hold up money. The class is noisy but the students are involved. I focus on those children who are not ready with a solution by asking questions. I draw their attention to me again by saying "mouth closed eyes this way 1, 2, 3, if you're doing something other than listening to me you are doing the wrong thing…Tyne".

28:

29: I remind them that when children share their solutions we have a rule about giving them the same attention we give the teacher. I then go on to select pairs of students to share their solutions. I ask if anyone has a different solution, when children volunteer we listen to their solution and check if it makes sense.

30:

31: The children swap roles again. I settle them by saying "Wallis your name is about to come off my good side, I'm not going to say another word until everyone's ready" I wait for the room to get quiet. I reward Reese by putting his name under the smile.

32:

33: The next problem is to buy an iron for $80 I say "work it out with your partner, if you're the shopkeeper you have to make sure you're getting the right money". A student asks about giving change, I explain that we aren't giving change today, we have to give exactly the right money.

34:

35: The room is noisy but busy, I focus on Charlie and Vic, they often don't keep up with the class. A group of three children asks a question which I respond to. "Vic I'm sick of asking you to be quiet."

36:

37: I ask a pair to show what they have as a solution. I respond "you are exactly right" I ask another couple, I check their answer by calculating out loud ("four $20 notes"). The noise in the class has increased. I ask another couple to share their solution but I interrupt them with "oh excuse me, I don't think people are remembering our rule of listening when someone else is talking". Another group of children gives an answer. I say again "the room is too loud I can hear your voices out here, whispering please". I hand out the textbooks, one child's book is missing, I look for it.

38:

39: The text page is p. 62, I write it on the whiteboard. Children are continuing to play with the money I say "leave that money alone in the middle of your desk, page 62 please". I individually direct several students who are not on task. I remind the students that when they write money they don't just write the number but the dollar or cents signs. I show them on the whiteboard.

40:

41: I lead the students in answering Question 1 together. One student gives an incorrect answer, I correct it. I tell the students to do the second question, I give time for them to work it out. The answer is one dollar, several students think the answer is 100 cents, I talk about 100 cents being one dollar, and that's how we normally refer to it.

42:

43: The students are directed to finish the next set of questions. I direct the students to use the plastic money on their desks, if they need to, when answering the questions. I focus on individuals and say things like "Wiley have you finished all of the boxes? Hurry up and do them please…Vic sit on that seat…Wiley concentrate".

44:

45: I explain the whole page in the textbook step-by-step, giving time as I go for the students to complete a question. I focus again on Charlie and his progress. I continue reading the page aloud and waiting while the students complete their work. Wiley asks a question, I walk over to him. The coins he has in front of him are inadequate to answer the question, so I get him more. Charlie asks for help, I help.

46:

47: Two of the questions in the text page required children to focus on the appearance of animals on the coin. I'm not sure of the necessity for this.

48:

49: The children are directed to put their books in a pile and sit on the floor, which they do. I ask the class "Do you feel happy about how you can use your money now?" They respond positively. I give the stickers out to people under the smile and say to the children "give them a clap please". While this is happening children on the floor are unsettled. I say "lots of silly people… settle down".

50:

51: I show the class a new book they are about to get. It is a speed test book. I give one to each student and ask them to put their names on them. This is quite an unsettled time, I say things like "excuse me guys…Wiley you're doing the wrong thing”. The children take their books to their desks and write their names on them and bring them back.

52:

53: "Okay who's ready? In response to a child's question I focus on the recording equipment. It is the last day of the week and I ask the children who have had their names under the smile every day in the week to get their rewards cards from their classrooms and bring them to me. While completing these cards I continue to try and keep the other students settled.

54: **General Notes:**

55: I don't smile a lot though I seem pretty relaxed.

56: There were a few behaviour management issues particularly at the end of the lesson. I think I handled them okay. There are a few ‘difficult’ children. I was calm and cool in my manner when under pressure e.g. end of lesson, I felt very frustrated but I was determined to be taken seriously.

57: The investigation of the addition facts of 5 went quite well. The squares aren't ideal, a bit fiddly, but everyone has a set, which is great. Some children struggled with how to use the squares to show the facts (white and coloured sides). Some children are picking up the patterns (see book for visual of the patterns). I think this is part of my focus this term, while it isn’t problem solving, it is investigative, to try and get the children to understand the patterns instead of rote learning number facts. This was a start, not a great one, but hopefully it will improve with repetition and familiarity.

58: We didn't write the facts up on the whiteboard or talk about them as a whole class, I think this would be good but today it was an introduction to the use of the squares.

59: The money lesson was teacher directed but it was problem solving i.e. more than one solution, all solutions accepted, incorrect solutions discussed and modified. This is the focus of this cycle of my action research. I am at the early stages of trying to implement it and it seems to have been reasonably successful in this lesson. I would like this type of activity to take up more time, but that is not possible with the textbook focus, so I think it was alright.

60: I think the atmosphere in the class is positive, students seem to feel safe and are comfortable to share answers. I think I need to work harder at modulating my voice and smiling more (that may be due to being recorded).

61: Again the textbook section of the lesson was very teacher directed. I read out the questions to make sure that literacy didn't impact on understanding. I gave time for answers, but some students are very slow at completing their work (e.g. Wiley and Charlie). I got a surprise when viewing the tape that I spent so much time on them doing their work.

62: I spent a fair bit of time on disciplining a few of the students (e.g. Vic and Tyne) but this didn't surprise me, in reality, I feel more time is spent on this than I viewed on the video (maybe I feel I am managing behaviour even when things are going well, I am always on the lookout, a bit like keeping all the balls under the water at the same time).

63: I found the money text page a bit frustrating when we had to focus on the picture on the coin. As a regular user of money I have no idea what picture is on what coin and I still manage to know the value of the coins for practical use. Is this necessary? Surely this is a HSIE topic about why something is so important to Australia that it gets on a coin. The plastic money was inadequate too as there were two different types, and one was not the correct size. Some coins were not replicas of the real thing.

64: The transition times in the classroom were too long (especially the last part). I need to focus on improving this, it is a behaviour management issue and requires clear guidelines and follow-up for acceptable and unacceptable behaviours. I am doing this but need to continue to be fair and consistent.

Video notes Year 2 – 27.6.02

1: **Note**: All names except those of my family are pseudonyms.

2: **Video Notes Year 2 - Term 2 Week 9 27.6.02**

3: **Focus:** Provision of non-routine problems

4: I explain the videotaping and answer any questions. I remind the children of the expected behaviour in the classroom. I explain the speed test they are about to do. A child speaks to me without putting up his hand I remind him that he is required to put up his hand and wait for the teacher to ask him to talk.

5:

6: The speed test books are already on the tables so the children are asked to look for their seats (the children do not have set seating, I put the books out before each lesson, selecting where I want them to sit). While people are looking for their seats I say "I'm looking to see who's most sensible". I put names under the smile on the whiteboard. I say "some people are taking a long time…Tyne settle down… mouth closed please… speed test number 16 is where we're starting". The noise level in the class is too high. In a raised voice I say "Mrs Forrester's voice is the only one we should hear unless you (further explanation)... put on your maths tracksuits and your maths joggers, we're going to do our training session now… see how fast we can be on our first day of 10" (this is the first speed test on the number facts of 10 after their investigation of these facts). I count them in, they start their speed test. Joey is not doing his speed test but tying his shoe laces, I direct him to stop and start on his speed test. Another child is talking, I put my finger to my lips to remind him to be quiet. I watch the pupils while they work, I get a booklet to prepare for marking, I tell them one minute has passed. I notice a student is looking at someone else's work surreptitiously I say "Wiley I hope you're doing your own". They keep working, I say "two minutes gone". I remind Reilly to do his own work.

7:

8: I say "pencils immediately down". The children get ready to mark their work, I remind them to get their coloured pencils ready. I read out the questions and answers slowly and stop at the bottom of each column to make sure students can keep up and find their place. I am looking at the booklet and the children and in the middle of reading out the answers I say "Rhys sit down". As some children finish marking earlier than others (because they complete less questions in the time) they tend to have a chat, I have to remind them that other children are still marking. When the marking is complete I say "listening carefully please, on the front page, at run number 16, write how many you got right and whether you're happy or not with what you got…". There is an option on the book to draw a smile or frown on a face next to the score. I then tell the children to put their books in a pile and come and sit on the floor. I sit and wait while watching the children follow the instruction. I say "Wiley we're waiting. Reid put it away please". I pick up the whiteboard marker and thank Remi and Reilly and put their names under the smile. Matisse says "I did the wrong ones". I clarify what he means (he did the wrong set), I say that's okay, and that I will mark it later.

9:

10: I say "We've got some fun things to do but we'll have to do them a bit later, Von that's not what you should be doing…". I explain that we're going to do page 77 of the textbook together. I get sidetracked by a child with his finger up his nose, reminding him to be healthy and get a tissue. Some children are being noisy I say "please don't make it chat time. Get your book and take it to your table and get your pencil ready". I ask a child to be more sensible. I say "lead pencil ready. Thank you very much Shelby, I think you were the quickest. Wiley if I see your head on the table again today your name will go under my frown". (I have noticed Wiley is putting his head on the desk nearly every day, I have spoken to his teacher about it and it is something he does in his regular classroom as well). I make a comment that perhaps if he is tired he might need to go to bed earlier.

11:

12: I begin to read the page from the textbook and explain that addition problems which are vertical or horizontal still mean the same thing. I tell them that they can use Unifíx cubes if they want to. I say "I'll do the first one on the board so you can see". The question says there are 9 balls and another 6 balls, how many balls altogether? I write on the board 9 + 6 = 15. Then I write the answer again on a dotted line I have drawn to replicate the setup in the textbook. I read the next question and say "you might do it with your cubes, you might do it with your fingers, you might lock the big number in your head and count on, it's up to you". In the past addition signs have been written in the book, on this page there are no addition signs, I tell the children they will need to put the signs in. Matisse asks about putting subtraction signs and I explain that as we are adding things together we need to use the addition sign.

13:

14: I walk around the room asking questions and checking work and watching students. I ask children not to go ahead in their textbook work but to wait so we can do them together (I find the disparity in the speed at which children do things to be very difficult to manage especially with textbook work, some children go ahead but their reading skills mean they don't answer the question correctly because they haven't understood it. It then becomes more complicated because they don't listen when I am explaining it to the whole class and so miss out on it completely).

15:

16: I say "mouths closed eyes this way 1, 2, 3". Charlie catches my eye being settled and ready (this is not common). I say "well done" and put his name under the smile. Five different students are mentioned by name to get their complete attention.

17:

18: I explain and demonstrate the next question. Two students' names are mentioned to gain their attention. I then tell the class "off you go". Matisse asks for help. I go to him to explain and go over his previous work. When I have finished I say to the class "if you finish all of those things put your hand up and I'll come to you" a student makes a comment about copying I say "you don't copy anything you'll have to work them out". I help a student and show him what to do with Unifíx cubes. As I walk around the room I make comments such as "well done". Ash is having difficulties (he struggles with understanding mathematical concepts), he asks for my help, I explain verbally and by using the Unifíx cubes and he joins in counting them.

19:

20: Someone says they have finished the whole page so I offer them the opportunity to do a hundreds chart puzzle. As children are finishing they come to the front with their completed work and get a puzzle to complete. I continue to walk around watching the children still working at their desks, stopping to give puzzles to early finishers. Two students are spitting, I call them up and talk to them about acceptable behaviour. One child is off task I say "make it quick Tyne we are running out of time". I observe a child on the video completing the task by locking the big number in his head and using his fingers to count on, and for bigger number using the Unifíx cubes to count on.

21:

22: I continue to walk around while students do puzzles and stragglers finished their textbook page. I encourage students who finish their puzzles to swap. When I run out of puzzles I encourage students to join in a group. I say "I'm going to give people at their desks two more minutes to finish what they're doing… okay one more minutes to go…Reilly have you finished? Hurry up please, you only have 30 seconds to go… people on the floor pack up the puzzles please… okay I'm going to count to 100 by fives. When I get to 100 everyone will be seated on the floor with their mouths closed". I start to count, children join in. Nearly everyone is ready, I say "Ooo close Tyne you did well, okay Zane are you nearly finished? Reese I can't go by you mate, thank you very much, excellent behaviour". I put a tick next to his name under the smile and say "he's sitting very quietly and sensibly".

23:

24: I explain that we are going to do something in pairs at the tables and if we have time we'll share what we have done with the other members of the class. I remind the students of how we work in pairs: sharing, doing our best work, being sensible, agreeing on a solution together. I go through this twice and I tell them that the best pair will get a sticker. I tell them that I don't mind if their solution is incorrect our focus is on our thinking. I say "even if it's an incorrect solution I don't mind, right or wrong isn't what we're after but what we're thinking…".

25:

26: I remind them that we did the facts of 10 yesterday. I say "here's my question, I have 10 balls, I bought them on two shopping trips. How many did I buy on my first shopping trip and how many on my second shopping trip?". I write = 10 on the board, four times. I ask four students to give possible solutions and write up their answers on the board using the = 10s written there. The children seem very comfortable with this. I say these are my "easy peasy questions" and now I will give them one that they can answer in pairs. I remind them that they may have the opportunity to come up and explain their solutions.

27:

28: The question is "there are 19 children in a class, how many boys and how many girls?". I tell them that 19 is a "big number" and encourage them to use their Unifíx cubes. They go to their seats. I remind one child of appropriate behaviour with a word and a look. I encourage everybody to hurry up and remind two people to work together. The children work together in pairs while I watch on. I call the class to attention using "1, 2, 3", congratulate Reese for being "fast as lightning" then turn to another child and say "Tyne this is your last warning (with a stern look)". I tell the class they have two more minutes to get an answer and if they have one already they need to find another answer.

29:

30: I move a table to the centre of the room. I walk around and watch the children and say "you've got 30 seconds left". I call them to attention by saying "1, 2, 3,…Parker I think you were the best then, thank you so much".

31:

32: I select two children and ask them to bring out the Unifíx cubes and show us their answer. I explain again that the children are to have nothing in their hands and are to give the children out the front the same attention as they would give too me. Some children continue to touch things on their tables and I remind them by name to do the right thing. I remind the whole class that this is part of being a great pair.

33:

34: Raine and Charlie are out the front, Raine uses two sticks of Unifíx cubes to represent 8 boys (yellow) and 11 girls (blue). I say "okay people at your desks, double check to see if that's correct". Charlie then shows the class their other solution of 9 boys (yellow) and 10 girls (blue) equals 19 children. "People at your desks did that add up to 19?" A lot of the children answer yes. I thank the children out the front and ask them to sit down. I say "people who are touching equipment are doing the wrong thing".

35:

36: I choose another two children to come out the front, Matisse and Rhys. They show their sticks of Unifíx cubes which represent their solution of 14 boys and 5 girls equal 19. I say "everyone have a look, did they make a mistake? Are there 19 people in that class? How do you know so quickly Saxon?" I ask Saxon to come out the front and explain how he checked the solution so quickly, he explained that he locked the big number in his head and added on. I congratulate his good thinking. I congratulate two students for not touching things and listening so well.

37:

38: Another two children come to the front. Remi gives the solution of 19 girls and 10 boys equalling 19 children. I ask the class to check, many respond quickly. I ask Shelby to come out the front and show us how he checked so quickly he said he looked 10 in his brain and counted on using his fingers (showing us). I quietly tell two students they are doing the wrong thing. I ask other students and they explain, Saxon says he used a near double and explains 10 + 10 = 20 - 1 = 19. Respond with "wow!... good thinking". Wallis gives his solution of the 11 boys and 9 girls equalling 19 children. I ask the class to check the solution, and repeat my disappointment to those not paying attention to each other. I ask Ash and he explains he checked it by locking the big number in his head and counted on. I say "we've got a lot of solutions on the board, I wonder how many solutions there might be. When we did facts of 10 there were 11…" one child suggests twenty solutions (one more than 19), and I suggest it would be a good idea to investigate that some time and see if he's right.

39:

40: I explain that in the next term of school we are going to do a lot more of listening to each other explain things to the class. I have a stern talk to them about listening and learning from each other.

41:

42: I ask the class to pack up and go to the floor. While they pack up, I talk to a child. I call the children to the floor. When they are settled I wish them well for the school holidays. I give out stickers to those children whose names are under the smile and ask the children to applaud them for their nice behaviour. I give a reward for great pair work. While this happens some children are chatty, I ask for "mouths closed please…Tyne shhh", I notice a child doing the right thing while waiting and give that child a sticker too.

43: **General Notes:**

44: I was not 100% well and I look flat to start with but I brighten up as the lesson progresses.

45: The speed test was done quickly and marked quickly, this is going well. The concept of maths joggers and tracksuits, to do our maths workout in, has worked well as a way of easing the children's view that this is a competition with other students rather than strengthening our mathematics brains by practising.

46: A fair bit of time was spent this lesson making behavioural requirements clear. These requirements were both general and specific (pair work; listening to other students). The lesson is at the end of June and I am still needing to do this, even then it is a struggle for them, especially listening to other children justify their solutions.

47: I seemed to spend a lot less time showing Matisse and Charlie what to do. I'm not sure if this is a one off, or whether today was a good day. I need to think about it (interesting that it comes to mind while watching the video).

48: The puzzles for early finishers went well (despite the hiccup of leaving them in the car). I think the pace of the lesson goes quite well, not too long on any one thing.

49: The students are more comfortable with non-routine problems. This has taken a while but is paying off.

50: The textbook page takes a long time for some students. I try to maximise time by marking it all myself but it takes me 40 to 60 minutes depending on the page. I've tried getting the children to mark it, but they are not reliable and that also takes a lot of time, time we can spend on more interesting activities (I wasn't sure which way was best, but this is a benefit. I don't know if I could maintain doing all the marking if I was teaching all subjects).

51: I was quite happy with the end of the lesson in terms of sharing solutions. I think it was properly closed even though not all children listened or cooperated. I am improving in this area, on getting children to verbalise their thinking strategies and I am remembering to do that rather than just getting their solutions and declaring they are right or wrong.

52: My explanation about right and wrong solutions went quite well. I feel those explanation segments were quite clear, and expectations in this class generally fit within what I verbalise. Although the right/wrong textbook solutions are not in line with this approach and I don't know what the children's thinking is while completing the textbook when I mark them after the lesson. I do my best to walk around and listen to them working, asking questions to clarify thinking. But I often forget who said what, and I have tried but find it difficult to take notes or tick boxes and do all the other things I am doing (even if these are not obvious outward actions, I am thinking flat-out about all sorts of things including discipline, content, children's thinking, what I'm going to do next in the lesson, responding to a question and thinking how I can help a child). I presume as my confidence had experience grows I will have less of that happening in my head and will find the assessment of mathematical thinking more manageable.

Video notes Year 2 – 12.9.02

1: **Note**: All names except those of my family are pseudonyms.

2: **Video notes Year 2 - 12.9.02 - Term3 Week 8**

3: **Focus:** lesson closure and discussion

4:

5: The lesson opens with children coming up individually and writing an addition fact of 15 on the whiteboard. I nominate someone, they get a marker, write the fact, give their marker to the next child and sit down. The children are relaxed with this, as it is a regular part of the lesson, when they are investigating the number facts of a new number. The process is time-consuming, it would be quicker to do it myself (but they are a lot quicker at it than they were). One child writes up an incorrect attempt. I help.

6:

7: "Good morning. We all know our patterns. Let's get rid of one half of them. Which half?" The children decided the patterns with the bigger number first would be kept. They decided to get rid of + 0,+ 1, + 10 (because when we add 10 to anything it is easy to work out). I explain how this helps when adding 9, writing 9 + 6 = 10 + 5 (+ 1 and -1) on the board. We talk about other strategies for working out number facts e.g. lock the big number in your head, doubles or near doubles (8 + 8, 7 + 7, 7 + 8, 8 + 7). We finish this section with me asking them to select one number fact left on the board (after rubbing off those facts that don't need to be remembered) and repeat it three times in their heads.

8:

9: The children are told to find their seat, a pencil and open their books to the next speed test. They are given a time limit to get ready. "Some people are taking much too long to find their seat and pencils". The speed test is four minutes long. I walk around the room watching the children, commenting to some children to bring them back on track if they are distracted or talking to someone. You can see students using different strategies to solve the number facts questions e.g. adding on the smaller number by counting using fingers. I tell them when the four minutes is up by saying "pencils down". There are some questions about marking details which I answer. I tell them to select a coloured pencil, I call out the question and the answer slowly and the children mark their work, I take a break at the end of each column (to help children know where they are so they don't lose their place). While still marking I pause and tell the children who have marked all of their answers already (children complete different numbers of facts) to "circle the double that equals 14 and the near double that adds up to 15”. I continue to call out the answers, this time to related subtraction facts. The children become noisy, I say "my voice is the only one I should be able to hear". They settle. The children are asked to put their speed test books in a designated spot and come to the floor. I reward those who are quick and quiet by putting names under the smile on the second whiteboard. I tell the children that I will know they were listening if I can see their eyes looking at me.

10:

11: The text page they are going to complete today is p. 107. The content of the page is the subtraction facts to 20. I explain what the questions require of the children. I question the children as a means of clarifying what they are required to do. I talk about a question involving a picture on the page that looks a little like a domino. I use the term ‘half’ in referring to each side of the picture, but in fact the rectangle is not cut in half. I clarify this by saying that to really be a ‘half’ both sides must be equal. The children need to write a number sentence to match the pictures e.g. 3 + 9 = 12, 3 + ____ = 12 or 12 - 9 = 3. The number sentences have to do with the picture. The children have been having trouble completing number sentences in their textbooks. They seem to make them up and often they appear to have nothing to do with the pictures. To make sure the students complete the questions correctly today, I ask them to circle the number sentences with the appropriate picture (I am using several strategies to manage behaviour e.g. “Are you watching?" "I don't think that's a good idea"). I walk around looking at all the students work to see if they have circled the related sentences.

12:

13: I ask them to try to do the next question by themselves, if they finish they are to go onto the following question and are encouraged to use Unifíx cubes or fingers to work out their solutions. I go around checking on students. Matisse tells me he can see the ‘trick’, I tell him that there is no trick but that we can work it out. I ask individuals questions to keep them on task and/or clarify requirements. "How's it going Whitney? I give advice to make sure they answer the questions on the page e.g. "don't get tricked by ‘plusing’ at the end, they are ‘takeaway’".

14:

15: I turn the whiteboard around to write on the other side. I write up a non-routine problem while the children are still working in their textbooks: "Gill scored 14 runs in 2 softball games. How many runs did she get in each game?" I turn towards the children and say "pencils down 1, 2, 3. Ray is quick today, I will have to put a tick next to his name!" I explain the question to the children and ask them to show an addition and an associated subtraction number sentence using Unifix cubes and laminated number and symbol cards.

16:

17: I walk around the room looking at students and helping them, bending down to listen to individuals. There is a busy noise in the room. I warn them that it is nearly time to finish "I'm looking for someone who has got the number sentences, and the Unifíx cubes and they are going to show the class in two minutes".

18:

19: I go through the process with a student. I ask Charlie if he has finished, wanting to make sure that everyone has had the chance to finish (Charlie can be slow). I build on what a child has done e.g. "you've got a ‘plus’ sentence there can you show me a ‘minus’ sentence?" I go through a student’s solution with him getting him to explain what he has done. One child did not understand the question so I explain it to him again, although this is very late in the lesson, and there is no time for him to complete it. I call the class to attention by saying "we need to pack up now, eyes this way, mouth closed 1, 2, 3". I ask a child to come to the front and show the class his solution. He gives the solution 7 + 7 = 14. I ask him his ‘takeaway’ question. We look at another child’s solution 8 + 6 = 14 and I hold up his Unifix cube solution. I want to make sure that the connection between addition and subtraction is clear so I say “I want you to put everything out of your hands…” I demonstrate several times putting the two stick of Unifix cubes together to get the addition solution and taking a number of cubes away from the stick for the subtraction sentence.

20:

21: I select several students’ solutions and they share them with the class. The class generally is unsettled and distracted. I ask them to pack up and sit on the floor as quickly as possible.

22:

23: I hand out stickers for those under the smile on the board. “Sitting on the floor and sitting quietly” is said to keep those waiting settled. The students who got stickers help pack up while the others go back to their classrooms.

24: **General Notes:**

25: I seem uptight. I don’t know if that’s how I always seem or if it is just the result of being video-taped.

26: The children know the routine well e.g. they knew exactly what to do with the number facts on the whiteboard.. They knew about locking the bigger number in your head, doubles (there were none) and near doubles, adding zero and not changing the number, adding one making it one bigger. Making tens e.g. 9 + 6 = 10 + 5 or 10 + 6 - 1.

27: Watching myself - I am more aware of my ‘teacher focused’ teaching than when I am doing it. I find it hard to let them ‘discover’ or ‘justify’ without taking over. I need to work on this.

28: Questioning - I want to have another look at my questioning on the tape. Is it another way of explaining? Is it ‘please the teacher’?

29: I did give thinking time at the beginning - I liked that. Could it have been used better elsewhere?

30: The children didn’t give other children attention when they were explaining their answers - how do I work on that?

31: Was the write up time at the beginning too long? How can I reduce that and still let this activity be student centred? Is that possible?

32: Focus for future?

Year 4 Mathematics Program, Term 1, 2003

Note: All names except those of my family are pseudonyms.

1: **Mathematics Overview**

2: **YEAR 4 MATHEMATICS**

3: **Outcomes for Term 1** - taken from *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002).

4: **Working Mathematically**:

5: WMS2.1: *Asks questions that could be explored using mathematics in relation to Stage 2 content.*

6: WMS2.2: *Selects and uses appropriate mental or written strategies, or technology, to solve problems.*

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10:

11: **Number:**

12: NS2.1: *Counts, orders, reads and records numbers up to four digits.*

13: NS2.2: *Uses mental and written strategies for addition and substraction involving two-,*

14: *three- and four-digit numbers.*

15: NS2.3: *Uses mental and informal written strategies for multiplication and division.*

16: NS2.4: *Models, compares and represents commonly used fractions and decimals, adds and subtracts decimals to two decimal places, and interprets everyday percentages.*

17: NS2.5: *Describes and compares change events in social and experimental contexts.*

18:

19: **Patterns and Algebra:**

20: PAS2.1: *Generates, describes and records number patterns using a variety of strategies and completes number sentences by calculating missing values.*

21:

22: **Data:**

23: DS2.1: *Gathers and organises data, displays data using tables and graphs, and interprets the results.*

24:

25: **Space:**

26: SGS2.1: *Makes, compares, describes and names three-dimensional objects including pyramids, and represents them in drawings.*

27: SGS2.2a: *Manipulates, compares, sketches and names two-dimensional shapes and describes their features.*

28: SGS2.2b: *Identifies, compares and describes angles in practical situations.*

29: SGS2.3: *Uses simple maps and grids to represent position and follow routes.*

30:

31: **Measurement:**

32: MS2.1: *Estimates, measures, compares and records lengths, distances and perimeters in metres, centimetres and millimetres.*

33: MS2.2: *Estimates, measures, compares and records the areas of surfaces in square centimetres and square metres.*

34: MS2.3: *Estimates, measures, compares and records volumes and capacities using litres, millilitres and cubic centimetres.*

35: MS2.4: *Estimates, measures, compares and records masses using kilograms and grams.*

36: MS2.5: *Reads and records time in one-minute intervals and makes comparisons between time units.*

37:

Reporting Outcomes - taken from *Mathematics K-6* (NSW Department of School Education, 1989)**:**

Number:

- Orders whole numbers up to 9999
- Adds combination of 1 and 2 digit numbers to 99 with trading
- Solves subtraction problems to 99 without trading
- Recalls multiplication facts involving 8 and 7
- Relates multiplication and division number sentences
- Trades smaller notes or coins for a note of greater value
- Records 100ths as a decimal fraction
- Expresses fractions in 10ths

Space:

- Can construct and compare angles
- Can make tessellations using tiles and blocks
- Describes, nets, skeletons and cross sections of pyramids
- Recognises the top, front and side views of given 3D shapes
- Constructs simple maps and plans
- Interprets column graphs

Measurement:

- Estimates the length or width of objects
- Constructs a square metre
- Makes and uses a half-litre calibrated container
- States the mass of an object to the nearest half kilogram
- Measures and records temperatures using an informal scale
- Is able to state facts associated with time e.g. 60 seconds = one minute

68: **TERM 1 PROGRAM**

69: **Week 1 and 2** in home groups:

70: WMS2.2; WMS2.3; WMS2.4; NS2.2; NS2.3; PAS2.1

71:Speed test every day (done).

72: Around the world - basic addition facts (done).

73: Number

74: Addition:

75: Students:

76: Investigate number patterns in addition facts (done).

77: Investigate number patterns in multiplication tables (done).

78: Investigate number patterns when adding numbers (done).

79: Explain patterns to the class (done).

80: Explain addition strategies to the class (done).

81: **Resources:**

82: *"It all adds up"* by P. Skinner (1998)

83: Unifix cubes

84: 100s charts

85: Counters

86:

87: **Evaluation:**

88: Addition

89: Students identified patterns and verbalised strategies.

90: They loved using Unifix cubes to 'see' patterns.

91: Some students could identify 'common factors'.

92: Some are very competitive at tables and basic facts recall.

93: I introduced the concepts - rather than drawn out of discussion - that "maths makes sense" and "maths is about patterns".

94:

95: **Week 3** in mathematics groups: Speed test every day.

96: WMS2.2; WMS2.3; WMS2.4; NS2.2; NS2.3; PAS2.1; SGS2.2a

97: Speed test every day (done).

98: Around the world - basic addition facts (done).

99: Number:

100: Addition:

101: Students:

102: Investigate number patterns in addition facts (done).

103: Explain patterns to the class (done).

104: Explain addition strategies to the class (done).

105: Look at repeated addition (done).

106: Space:

107: 2D Space:

108: Investigate lines of symmetry in the classroom, classifying objects into 1, 2 or more and no lines of symmetry (done).

109: Discuss findings with the class (done).

110: Make a symmetrical pattern on computer drawing program (not done).

111: Text pages 94, 95 (done).

112: **Resources:**

113: *"It all adds up"* by P. Skinner (1998)

114: Unifix cubes

115: 100s charts

116: Hundred charts

117: Counters

118:

119:

120: **Evaluation:**

121: Addition

122: Students identified patterns and explained several to class.

123: Students explained addition strategies (particularly using 10 and doubles or near doubles).

124: Made connection between addition and multiplication.

125: Discussed "maths makes sense" and "maths is about patterns".

126: 2D Space:

127: Students seem to understand lines of symmetry - could verbalise why the door without handle and hinges was symmetrical, yet asymmetrical with handles.

128: The term asymmetrical was introduced.

129:

130:

Week 4:

WMS2.2; WMS2.3; WMS2.4; NS2.3; PAS2.1

Speed test every day (done 3 days out of 4).

Around the world - 2 times tables (done).

Number:

Multiplication:

Students:

Investigate number patterns in multiplication tables (done).

Explain multiplication strategies to the class (done).

Identify overlapping patterns in different tables - common factors (done).

Complete text pages 45, 49 (done).

Resources:

Counters

Symbol and numeral cards

Hundreds charts

Coloured squares

165: **Evaluation:**

166: Multiplication:

167: All students could identify ‘common factors’ - though we didn't use this term.

168: Text pages competently done.

169: Children could see patterns in tables.

170: Used symbol and numeral cards with coloured squares to demonstrate different multiplication tables in groups.

171: Mathematics diagnostic test.

172: Diagnostic test administered. All students seemed relaxed.

173:

174:

175: **Week 5:** WMS2.2; WMS2.3; WMS2.4; NS2.1; SGS2.2b:

176: Speed test every day – (done - three out of four days).

177: 4 times tables race (done).

178: Around the World - 4 times tables (done).

179: Diagnostic test for gifted and talented program (done).

180:

181: Number:

182: Numbers to 999:

183: Students:

184: Model numbers over 100 using MAB blocks (done).

185: Text pages 1, 5 (done).

186: Space:

187: 2D Space: Angles

188: Students:

189: Construct different angles using geostrips (done).

190: Construct different angles using geoboards (done).

191: Investigate angles in the room (done).

192: Compare angles with arms of varying lengths (done).

193: Discuss findings (done).

194: Report findings in mathematics grid book (not done).

195: Text pages 97, 101 (done).

196: **Resources:**

197: Photocopies of Year 4 diagnostic test from back of text

198: Geoboards

199: Geostrips

200: Elastic bands

201:

202: **Evaluation:**

203: Number to 999:

204: Children modelled numbers over 100 using MAB blocks in groups - went fine.

205: 2D Space:

206: Angles kits not in mathematics storeroom. We did fractions from next week - see comments there.

207: We did angles in Week 6 - went well though whole class had difficulty putting the children's angles into order.

208: **Week 6:** WMS2.5; WMS2.3; NS2.4; MS2.1; PAS2.1

209: Speed test every day (done).

210: Around the World - 6 times tables (not done).

211: Number:

212: Fractions:

213: Students:

214: Investigate the equivalence of fractions e.g. 5/10 and ½, and predict other equivalent fractions using centicubes (done).

215: Discuss different ways of recording parts of a group (done).

216: Text pages 2, 3 (done).

217: Play Trade a Flat (done).

218: Measurement:

219: Length:

220: Students:

221: In groups students estimate then check measurements of body parts and objects to the nearest centimetre (done).

222: Discuss the centimetre, its abbreviation and accuracy (done).

223: Complete text page121 in rotating groups (done).

224: **Resources:**

225: Objects for measurement

226: MAB blocks

227: Centicubes

228: Dice

229:

230: **Evaluation:**

231: Fractions:

232: We looked at centicubes showing 5 out of 10 and discussed other ways we could describe it - we got: 5 out of 10, 5/10 and then a half. We went on to 1/2 and then talked about other fractions that were equivalent. For example: 10/20, 50/100, 250/500 etc.

233: Some children could not play "Trade a Flat" - they need some more instruction.

234: Length:

235: Length topic was done with the casual teacher. The text and activities seemed to be fine.

236:

237: **Week 7:** WMS2.5; DS2.1; NS2.1

238: Speed test every day (done).

239: 6 times tables game in pairs using symbol cards - 6 times the value of the card drawn = ? (done).

240: Number:

241: Numbers to 999:

242: Students:

243: Make numeral expanders (not done).

244: Play ‘Make a bigger number’ using the same numerals (done).

245: Discuss zero as a place holder (done).

246: Digit game (BLM 185, 182) (not done).

247: Text pages 6, 11 (done).

248: Graphs:

249: Students:

250: Use PDH data from homework to construct a tally and draw column graph in grid book in both horizontal and vertical forms (not done).

251: Investigate graphs in newspapers (done).

252: Complete text pages 149, 150 (done).

253: Students decide on a question to investigate, conduct research and complete a graph (done).

254: **Resources:**

255: Teacher’s resource p. 185, 182

256: Numeral cards

257: Place value charts

258: symbol cards

259: PDH homework from Week 4

260:

261: **Evaluation:**

262: The Teacher's Resource Book was not available, but is now on order.

263: Numbers to 999:

264: With this group there seems to be a good understanding of numbers to 999, as well as place value. Therefore, numeral expanders were not necessary.

265: Zero as a place-holder was well understood.

266:

267: Graphs:

268: Text pages were easily completed.

269: Newspapers produced lots of graphs.

270: We did three investigations: pets, family members, colours of cars. Children chose one to write up a graph in their grid books. They wrote questions based on the graph, which were answered by a friend. Some students did a tally in error, as a tally was written on the board. One did a picto-graph. This was a good opportunity to reinforce column graphs.

271:

272: **Week 8:** WMS2.1; WMS2.2; WMS2.5; NS2.1: MS2.3, MS2.4

273: Speed test every day (done).

274: 7 times tables race (not done) -We investigated six times tables instead.

275: Number:

276: Addition:

277: Students:

278: Complete open-ended addition tasks (not done).

279: Write their own addition tasks and share with neighbour to solve (not done).

280: Report strategies to the class (not done).

281: Discuss strategies for addition, including the importance of 10 (not done).

282: Text page 43 - already done - p.46 instead.

283: Measurement:

284: Mass, capacity:

285: To maximise the use of materials, rotating groups over two days, students:

286: Use text page 122 to estimate, measure and compare mass.

287: Use text page 124 to estimate, measure and compare capacity (not done). Money pp. 8, 10 instead.

288: **Resources:**

289: Balances

290: Containers

291: Sand

292: Water

293: Kilogram weights

294:

295: **Evaluation:**

296: Addition:

297: Page 46 was 2 digit addition (done with the casual teacher).

298: It was obvious that six times tables were not well known, and so the students did an investigation of six times tables, as high as they could go. They noticed patterns (e.g. numbers they ended in were 0, 6, 2, 8, 4, 0, 6, 2, 8, 4 etc.). One group wrote up the table for exhibition. I wish we had more time for exploration and reporting.

299: Mass:

300: Mass went well, and the availability of different weights that made 1 kg was worthwhile (for example 5 x 200 g).

301: Capacity:

302: We didn't do capacity (due to my illness I felt unable to supervise water activities).

303: Money:

304: Money on pp.8-10 was fine, some used plastic money to help solve questions. One open-ended question went well, but we ran out of time.

305: **Week 9:** WMS2.2; WMS2.4; WMS2.5; NS2.2; MS2.4

306: Speed test every day - (done) except Monday.

307: 7 times tables game (not done).

308: Number:

309: Subtraction:

310: Students:

311: Use base 10 material to perform subtractions for numbers up to 99 (done).

312: Challenge students to write an algorithm for multiple problems, both take-away (done) and difference type questions (not done).

313: Compare algorithms and discuss their value and ease of use (done but not adequately).

314: Text page 52, 59 (done).

315: Use money to perform subtraction problems (not done).

316: Trade a flat game (not done).

317: Measurement:

318: Temperature, Mass:

319: To maximise the use of materials rotating groups over two days Students:

320: Use text page 125 to estimate, measure and compare temperature. Not sure if completed page 125 (done).

321: Use text page 126 to investigate the kilogram (not done).

322:

323: **Resources:**

324: MAB blocks

325: Place value charts

326: Symbol cards

327: Dice

328: Thermometers

329: Containers

330: Kilogram weights

331:

332:

333: **Evaluation:**

334: Monday - we did temperature and time pages.

335: Time:

336: Time is easily completed to one minute by nearly everyone.

337: Temperature:

338: Temperature was done again on Tuesday to complete activity of making a scale and testing its use on a variety of temperatures. Went well.

339: Subtraction:

340: Wednesday - I was not at school - seems most children completed two pages of text on subtraction using trading.

341: Thursday - I challenged the children to use their own algorithm for subtraction and teach it to the rest of the class. The children had been taught an algorithm before (except three Year 3 students). I need to follow that up with the students to see how they are going.

342: Speed tests and investigations:

343: We have focused on 3, 4, 5, 2 and 6 times tables this term.

344:

345:

346:

347:

348:

349:

350:

351:

352:

353:

354:

355:

356:

357:

358:

359: **Week 10:** WMS2.2.5; WMS2.2; NS2.2; SGS2.3

360: Speed test every day (done).

361: 8 times tables game (not done).

362: Number:

363: Addition:

364: Students:

365: Students complete open-ended addition tasks e.g. Coby scored 18 goals in her netball game, how many did she score in each half? Jill scored 256 in two games of ten-pin bowling. How many did she get in each game? (This problem not done, an alternate problem was given to fill in missing numbers in a 2 times 2 digit addition - to enable a focus on trading). Students represent their results in a written form (done but not a report, just written attempts).

366: Present their reports to the class (done).

367: Compare ways of reporting (not done).

368: Talk about algorithms depending on the student reports, discuss those that work for all cases and their ease of use. Draw out working from the right and discuss – (done but not in detail or thoroughly).

369: Text pages (not done).

370: Space:

371: Position:

372: Students:

373: Follow directions to make a pattern using objects on their desks (done).

374: Follow directions to draw a pattern (done).

375: Hide an object in the room and describe its position (done).

376: Students hide an object and using position language guide their partner to it - (not done) no time.

377: Students design a drawing, and make the directions using position language to get their partner to complete it (done).

378: Text pages 100, 106, 107 (done).

379: **Resources:**

380: "*It all adds up!*" (Skinner, 1998)

381: Objects

382: Paper

383:

384: **Evaluation:**

385: We did a revision test from the back of the text.

386: Addition:

387: Videotaped.

388: Children investigated a problem similar to this one:

389: 3 ? +

390: 1 ?

391: ? 2

392:

393: Many students could identify unit combinations which required trading. Several made addition errors and thought they could get answers in the 60s, though a few could verbalise that this was not possible due to trading.

394: Discussion of the algorithm was not in detail or thoroughly.

395: Position:

396: Students were confident with position language in activity at desk. Some students struggled with activities in the textbook - tote trays were drawn and they had to identify the name of the person who owned the tote tray following written instructions.

397:

398:

399: **Week 11:** WMS2.1; NS2.1; NS2.2

400: Speed test every day (done).

401: 8 times tables game (not done).

402: Number:

403: Numeration: (done).

404:

405: Students:

406: Estimate the number of lollies in a jar, fill in a guess and place in a box.

407: Count and reward the winner (done).

408: Discuss estimation. When do we use it? (done).

409: Reinforce “maths makes sense” and the use of estimation (done).

410: Poster of thousands of characters - estimate and count (done).

411: Telephone numbers on a page - estimate and count - (done) - Centicubes in container instead.

412: Text page 7 (done).

413: Rounding off - when do we use it? Why? (not done).

414: Text page 21 (done).

415: Number:

416: Subtraction:

417: Students:

418: Pose open-ended subtraction problems.

419: E.g. Farmer Brown has 2 eggs in his basket, how many did he have, what happened to the others? (done).

420: Share strategies with the class (done).

421: Discuss take-away subtraction and counting-on subtraction as result of the discussion (done).

422: Text page 48 (done).

423:

424: **Resources:**

425: MAB blocks

426: Lolly jar

427: Poster

428: Phone books

429:

430: **Evaluation:**

431: Numeration

432: We talked about the use of estimation. We estimated and counted centicubes, figures in poster, jelly-beans etc.

433: Subtraction:

434: Students posed their own questions after completing several possible answers to this question (E.g. Farmer Brown has 2 eggs in his basket, how many did he have, what happened to the others?). We looked at the two types of subtraction and the children made questions in the two different categories. Most understood the two different types of subtraction.

435: Revision test:

436: We started revision test 2 from the back of the textbook. We ran out of time and need to complete this next term.

437:

438: **Evaluation of Term 1:**

439: It has become evident that rather than basic tables speed tests alone we need to investigate tables - see patterns and talk about strategies. We started doing this in Week 8. We will continue.

440: Being the more able class, most children are picking a lot of things up quickly. Despite this we are still pressed for time to cover the program.

Year 4 Mathematics Program, Term 2, 2003

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29:

30: **Measurement:**

31: MS2.1: *Estimates, measures, compares and records lengths, distances and perimeters in metres, centimetres and millimetres.*

32: MS2.2: *Estimates, measures, compares and records the areas of surfaces in square centimetres and square metres.*

33: MS2.3: *Estimates, measures, compares and records volumes and capacities using litres, millilitres and cubic centimetres.*

34: MS2.4: *Estimates, measures, compares and records masses using kilograms and grams.*

35: MS2.5: *Reads and records time in one-minute intervals and makes comparisons between time units.*

36: **Reporting Outcomes** - taken from *Mathematics K-6* (NSW Department of School Education, 1989)**:**

37: **Number:**

38: • Orders whole numbers up to 9999

39: • Adds combination of 1 and 2 digit numbers to 99 with trading

40: • Solves subtraction problems to 99 without trading

41: • Recalls multiplication facts involving 8 and 7

42: • Relates multiplication and division number sentences

43: • Trades smaller notes or coins for a note of greater value

44: • Records 100ths as a decimal fraction

45: • Expresses fractions in 10ths

46:

47:

48: **Space:**

49: • Can construct and compare angles

50: • Can make tessellations using tiles and blocks

51: • Describes, nets, skeletons and cross sections of pyramids

52: • Recognises the top, front and side views of given 3D shapes

53: • Constructs simple maps and plans

54: • Interprets column graphs

55:

56:

57: **Measurement:**

58: • Estimates the length or width of objects

59: • Constructs a square metre

60: • Makes and uses a half-litre calibrated container

61: • States the mass of an object to the nearest half kilogram

62: • Measures and records temperatures using an informal scale

63: • Is able to state facts associated with time e.g. 60 seconds = one minute

64:

65:

66:

67:

68:

69:

70:

71:

72:

73: **TERM 2 PROGRAM**

74:

75: **Week 1:**

76: Outcomes: NS2.3; NS2.4; WMS2.5; WMS2.3

77: 8 times table investigation (done).

78: Speed test on 8 times table (done).

79: Term 1 revision assessment (done).

80: Number:

81: Fractions and Decimals:

82: Students:

83: Model different hundredths using MAB material (done).

84: Order different hundredths using MAB material (done).

85: Text page 13 (done).

86: **Resources:**

87: MAB blocks

88:

89: **Evaluation:**

90: Number:

91: It was difficult to get everyone to complete the review test due to absences and G & T sessions with several students out. Therefore, it was completed over several days. I think there is some confusion about using flats, shorts and longs to represent the whole and hundredths. This is going to take a while for some children.

92:

93: **Week 2:**

94: Outcomes: WMS2.3; WMS2.4; NS2.1; NS2.3

95: Speed test on 8 times table (done).

96: Number:

97: Numeration:

98: Students:

99: Model four digit numbers. Discuss the relative size of 1000, 10 hundreds, 100 tens, 1000 ones (done).

100: Discuss place value and the use of zero as a place holder (done).

101: Practise reading and writing numerals (done).

102: Text pages 14, 15 (done).

103: Space:

104: 3D Space:

105: Students:

106: Investigate the properties of pyramids using 3D plastic models (done) in Week 6.

107: Text pages 93, 99 (done).

108: **Resources:**

109: MAB material

110: 3D plastic shapes

111:

112: **Evaluation:**

113: Students are enjoying the new speed test on tables and seem to be making progress.

114: Numeration:

115: Place value and use of zero as a place-holder is a difficulty for some children I think even though text pages were completed well.

116: 3D Space:

117: I could not locate 3D figures. This was done in Week 6.

118: Decimals:

119: We started decimals.

120:

121: **Week 3:**

122: Outcomes: NS2.3; NS2.4; MS2.1; WMS2.2; WMS2.3; WMS2.5

123: Speed test 8 times table (done).

124: Investigate 7 times table (done).

125: Number:

126: Fractions and decimals:
127: Students:
128: Discuss the use of the decimal point (done).
129: Text pages 22, 23, 24 using MAB blocks (done).
130: Model hundredths using shorts and flats (done).
131: Cover the flat with longs and talk about the part of the flat represented. Explore the relationship between longs and shorts (done).
132: Multiplication and division:
133: Explore the relationship between division and multiplication using concrete materials (done).
134: Represent exploration using numeral and symbol cards (done).
135: Introduce the division symbol (done).
136: Pages 69 and 70 (done).
137: Measurement:
138: Area:
139: Students:
140: Construct a square metre using newspaper (done).
141: Use the template to complete text page 128 (done).
142: **Resources:**
143: MAB blocks
144: Counting squares
145: Numeral and symbol cards
146: Newspapers
147:
148: **Evaluation:**
149: Students are getting good at identifying patterns in tables and sharing strategies.
150: Fractions and Decimals:
151: Students seemed to have coped well with decimal points, but some children are having difficulty with zero as a place-holder after decimal points.
152: Multiplication and Division:
153: Multiplication and division activities went well. I taught a small group that was having difficulty with the relationship between multiplication

and division using concrete materials and they seem to have understood. This needs reinforcing.

154: Area:

155: The measurement activities took a long time and needed to be taken into Week 4. All children had a go at making a template - but the construction itself was the problem for most of them. Three small groups made workable templates that could be transported. We ran out of time to pursue this enough due to review needs for upcoming assessment. NEED TO REVIEW.

156:

157: **Week 4:**

158: Outcomes: NS2.3; NS2.4; SGS2.1; SGS2.3; WMS2.5; WMS2.3; WMS2.2

159: Speed test on 7 times table every day (done).

160:

161: Number:

162: Students:

163: Investigate the equivalence relationship between hundredths and tenths using MAB blocks and symbols (done).

164: Complete text pages 26, 27 (done).

165: 2D Space:

166: Tessellations.

167: Students:

168: Use pattern blocks to identify which shapes tessellate (done).

169: Use pattern blocks to make a tessellation using one shape (done).

170: Make tessellations using more than one shape (done).

171: Text page 102 (done).

172: Position:

173: Students:

174: Complete page 114 of text on mapping (done).

175: Represent their own house in plan form (done).

176: **Resources:**

177: Pattern blocks

178:

179: **Evaluation:**

180: Number:

181: Some children are having trouble with this. I think the difficulty lies with use of MAB blocks and confusion with what they represent. Some children are having trouble distinguishing between tenths and hundredths, they are just playing with numbers.

182: 2D Space:

183: Pattern blocks were unavailable. We used tangram pieces instead. These worked well, although there were not a variety of shapes available.

184: Some children are still having trouble with repeatable pattern necessity when making a tessellation. The textbook didn't help as its printing was not precise and the gaps were not obvious to students.

185: Position:

186: Representing their own house in plan form was difficult for most children.

187:

188: **Week 5:**

189: Exam week.

190:

191: **Evaluation:**

192: 3D Shape:

193: We located the 3D shapes and completed the programmed activities from Week 2. Each group used a shape to make a net. Went well.

194:

195: Exams:

196: This was a tiring week with the three exams. Students seemed to cope quite well with it. The testing process is quite formal.

197:

198: **Week 6:**

199: Outcomes: NS2.3; NS2.4; SGS2.1; MS2.3; WMS2.1; WMS2.3; WMS2.2; WMS2.5

200: Speed test 8 and 7 times tables (done).

201: Number:

202: Money:

203: Shopping with multiplication (not done).

204: Students create shopping problems for their partners (not done).

205: Text page 25 (not done).

206: Space:

207: 3D Space:

208: Students:

209: Represent a 3D figure from different views in drawing form.

210: Using 3D shapes and objects from the pantry (done) Completed Week 7.

211: Text pages 110, 111 (done) completed Week 7.

212: Measurement:

213: Volume:

214: Investigate the litre, more and less than a litre (done). This was done in Week 7.

215: Make a litre calibrated container (done). This was done in Week 7.

216: Text page 129 (done). This was done in Week 7.

217: **Resources:**

218: Ice cream containers

219: 3D figures

220: Food items from the pantry

221: Bottles

222: Plastic money

223:

224: **Evaluation:**

225: Assessment completed here instead of regular program.

226: 3D Space:

227: Week 6 activities completed in Week 7.

228: Volume:

229: Measurement activity was written up as the procedure. This went well.

230: **Week 7:**

231: Outcomes: NS2.3; NS2.2; MS2.2; WMS2.3; WMS2.2; WMS2.4

232: Investigate 9 times table (done).

233: Speed test on 9 times table every day (done).

234: Number:

235: Subtraction:

236: Students:

237: Play flat buster - starting with a flat, throw two dice and subtract the sum (done).

238: Model subtraction using trading with MAB blocks and place value chart (done).

239: Write the algorithm for a subtraction problem using trading.

240: Text page 60 (done) we also did pages 73, 74.

241: Checking subtraction by addition using page 68 and MAB blocks (done).

242: Measurement:

243: Area:

244: Students:

245: Investigate the need for a unit smaller than a square metre (done). We did this in Week 9.

246: Use grid paper to trace and measure small objects using the square centimetre (done). We did this in Week 9.

247: Text page 131 (done). We did this in Week 9.

248:

249: **Resources:**

250: MAB blocks

251: Grid paper

252: Dice

253:

254: **Evaluation:**

255: Subtraction:

256: Students can trade but many struggle with the algorithm involving trading marks. They think they are playing with numbers and have to follow a set procedure rather than represent what they are doing. I have sat down with a table at a time and gone through it child by child (only two groups completed, three groups to go). I want to do two more days on this for the G & T children, they are missing it. I will set up Space on page 131 for early finishers, so I can work with the children I haven't worked with as yet.

257: Area:

258: This was completed in Week 9.

259:

260: **Week 8:**

261: Outcomes: NS2.3; NS2.2; WMS2.2; WMS2.3; WMS2.4; WMS2.5

262: Investigate 11 times table (done).

263: 11 times table speed test every day (done).

264: Number:

265: Subtraction:

266: Students:

267: Subtract with trading using MAB blocks and place value chart (done).

268: Text pages 73, 74 (done). We also did pages 60, 68.

269: Measurement:

270: Temperature:

271: Students:

272: Discuss need for formal measure for temperature (not done).

273: Examine the scale on Celsius thermometer (not done).

274: Text pages 133 (not done).

275: Research Anders Celsius as per p. 133 using library and internet (not done).

276: **Resources:**

277: MAB material

278: Place value charts

279: Thermometers

280: Internet

281: Library books

282:

283: **Evaluation:**

284: Subtraction:

285: We did more subtraction with trading this week. I had small groups on the floor to observe them in action, both with MAB blocks and pen and paper. This seemed to help some children, though a few were still not confident.

286: Temperature:

287: Not completed.

288:

289: **Week 9:**

290: Outcomes: NS2.3; NS2.2; MS2.4; WMS2.2; WMS2.3; WMS2.4; WMS2.5

291: Revision speed test every day on 6 times, 7 times, 8 times and 9 times tables (done).

292: Number:

293: Subtraction:

294: Students:

295: Subtract with trading using MAB blocks and place value chart (done).

296: Text pages 76, 77 (done).

297: Measurement:

298: Mass:

299: Students:

300: Using balances and weights gain more experience using the kilogram (done).

301: Using page 126 investigate the kilogram and the need for a smaller unit than a kilogram (done).

302: **Resources:**

303: MAB materials

304: Place value charts

305: Balances

306: Kilogram weights

307: Items for weighing

308:

309: **Evaluation:**

310: Mass:

311: We did the measurement activities earlier in the term due to assessment needs. Many students grasped the concept, some still had trouble with the written form and what it means.

312: Area:

313: We completed the programmed activities from Week 7.

314: As a class we discussed the need for cm squared.

315: We use grid paper to measure things as well as completing the textbook page.

316: We also did page 131 on cm squared paper.

317:

318: **Evaluation of Term 2**

319: It was very disjointed in terms of following the program. This had a fair bit to do with assessment and revision. Some things needed completing earlier than planned, other things got put back to do assessing.

320: The exams were basically the same as last year with minor adjustments - hence the need to change the program. The exams were very formal, but the children coped well - they are used to it.

Year 4 Mathematics Program, Term 3, 2003

Note: All names except those of my family are pseudonyms.

1: **Mathematics Overview**

2: **YEAR 4 MATHEMATICS**

3: **Outcomes for Term 3** - taken from *Mathematics K-6: Syllabus 2002* (Board of Studies NSW, 2002).

4: **Working Mathematically**:

5: WMS2.1: *Asks questions that could be explored using mathematics in relation to Stage 2 content.*

6: WMS2.2: *Selects and uses appropriate mental or written strategies, or technology, to solve problems.*

7: WMS2.3: *Uses appropriate terminology to describe, and symbols to represent, mathematical ideas.*

8: WMS2.4: *Checks the accuracy of a statement and explains the reasoning used.*

9: WMS2.5: *Links mathematical ideas and makes connections with, and generalisations about existing knowledge and understanding in relation to Stage 2 content.*

10:

11: **Number:**

12: NS2.1: *Counts, orders, reads and records numbers up to four digits.*

13: NS2.2: *Uses mental and written strategies for addition and substraction involving two-, three- and four-digit numbers.*

14: NS2.3: *Uses mental and informal written strategies for multiplication and division.*

15: NS2.4: *Models, compares and represents commonly used fractions and decimals, adds and subtracts decimals to two decimal places, and interprets everyday percentages.*

16: NS2.5: *Describes and compares chance events in social and experimental contexts.*

17:

18: **Patterns and Algebra:**

19: PAS2.1: *Generates, describes and records number patterns using a variety of strategies and completes number sentences by calculating missing values.*

20:

21: **Data:**

22: DS2.1: *Gathers and organises data, displays data using tables and graphs, and interprets the results.*

23:

24: **Space:**

25: SGS2.1: *Makes, compares, describes and names three-dimensional objects including pyramids, and represents them in drawings.*

26: SGS2.2a: *Manipulates, compares, sketches and names two-dimensional shapes and describes their features.*

27: SGS2.2b: *Identifies, compares and describes angles in practical situations.*

28: SGS2.3: *Uses simple maps and grids to represent position and follow routes.*

29:

30: **Measurement:**

31: MS2.1: *Estimates, measures, compares and records lengths, distances and perimeters in metres, centimetres and millimetres.*

32: MS2.2: Estimates, measures, compares and records the areas of surfaces in square centimetres and square metres.

33: MS2.3: *Estimates, measures, compares and records volumes and capacities using litres, millilitres and cubic centimetres.*

34: MS2.4: *Estimates, measures, compares and records masses using kilograms and grams.*

35: MS2.5: *Reads and records time in one-minute intervals and makes comparisons between time units.*

36:

Reporting Outcomes - taken from *Mathematics K-6* (NSW Department of School Education, 1989).

Number:

- States the place value of digits to 9999
- Solves addition problems mentally
- Solves subtraction problems to 99 with trading
- Demonstrates an understanding of the terms factors and multiples
- Uses known table facts to recall basic division facts to 100
- Tenders the correct amount of money for an item
- Compares and orders tenths
- Records 10ths using decimal form

Space:

- Makes tessellations through flipping, sliding and turning
- Reassembles a 7 piece tangram
- Represents 3D objects through drawing
- Constructs 3D objects from drawings
- Follows directions to complete a maze
- Constructs column graphs

Measurement:

- Records measurements using decimal notation
- Measures surfaces using square metres
- Measures capacities to the nearest 100mL
- Measures the mass of an object to the nearest 100 grams
- Measures and records temperatures in degrees Celsius
- Reads and interprets timetables

68:

69:

70:

71:

72:

73:

74: **TERM 3 PROGRAM**

75:

76: **Week 1:**

77: Outcomes: NS2.3; WMS2.5; WMS2.3

78: Discussion of 12 times table (done).

79: Speed test on 12 times table (done).

80: Diagnostic assessment test 7.03 (done).

81: Diagnostic assessment test 7.04 (done).

82: Mathematics competition (done).

83: Number:

84: Multiplication:

85: Students:

86: Using MAB blocks make rectangles to find all the factors of a number (done).

87: Introducing multiples and the relationship to factors (done).

88: Text p. 63 (done).

89: **Resources:**

90: MAB blocks

91:

92: **Evaluation:**

93: This went quite well. Some of the children still write a multiplication sentence rather than a factor.

94:

95: **Week 2:**

96: Outcomes: WMS2.3; WMS2.4; NS2.1; NS2.3

97: Speed test on 12 and 8 times tables (done).

98: Review diagnostic tests with students (done).

99: Number:

100: Numeration:

101: Students:

102: Using MAB blocks make rectangles to find all the factors of a number (done).

103: Review multiples and the relationship to factors (done).

104: Text p. 64 (done).

105: **Resources:**

106: MAB material

107:

108: **Evaluation:**

109: Diagnostic tests:

110: The diagnostic tests were completed. The children were very competitive. It was hard to convince them that this is a diagnostic activity and not assessable.

111: Numeration:

112: More exposure to factors was good, though a few haven't understood the concepts.

113:

114: **Week 3:**

115: Outcomes: NS2.1; NS2.2; SGS2.1; WMS2.2; WMS2.3; WMS2.5

116: Speed test 12, 4, 8 times tables (done).

117: Number:

118: Numeration:

119: Students:

120: Use base MAB blocks to represent four digit numbers looking at the value of shorts, longs, flats and blocks (done).

121: Look at place value and the use of zero (done).

122: Students represent the numbers in expanded notation (done).

123: Text pages 41, 42 (done).

124: Addition:

125: Students:

126: Use MAB blocks to model 3 digit addition with trading (done).

127: Text page 81, 82 (done).

128: Space:

129: 3D space:

130: Students:

131: Review pyramids and prisms using 3D shapes (done).

132: Construct pyramid and prism skeletons using pipe cleaners and straws (done).

133: Using text p. 99 as a basis, trace and draw 3D shapes with grid paper (done).

134: **Resources:**

135: MAB blocks

136: Grid paper

137: Pipe cleaners

138: Straws

139: 3D shapes

140:

141: **Evaluation:**

142: Numeration:

143: Most children can write 4 digit numbers with no trouble. There are just a few children still struggling.

144: Addition:

145: Those children who are confident that 2 digit numbers in addition, are having no trouble with modelling 3 digit addition with trading. Some children are still struggling with trading.

146: 3D Space:

147: The 3D space activity was good fun. Some children displayed really good efforts, but fine motor skills let some children down. I was surprised at the confidence of some children in drawing 3D shapes on grid paper, though some had difficulty.

148:

149: **Week 4:**

150: Outcomes: NS2.3; DS2.1; SGS2.2a; WMS2.5; WMS2.3; WMS2.2

151: Speed test on 12 and 8 times tables every day (done).

152:

153: Number:

154: Division:

155: Students:

156: Using MAB blocks give division problems involving no remainders and remainders and discuss answers (done).

157: Discuss relationship between division and multiplication (done).

158: Complete text page 71 with tables chart on the wall and MAB blocks (done).

159: 2D Space:

160: Graphs:

161: Students:

162: Discuss column graphs and tally graphs (done).

163: Look at scales on graphs (done).

164: Text pages 152, 153, 154 (done).

165: 2D Space:

166: Students:

167: Investigate tangrams using plastic tangram sets (done).

168: Text page 109 (done).

169: Take home tangram template for practice and play (done).

170: **Resources:**

171: MAB blocks

172: Tangram sets

173:

174: **Evaluation:**

175: Division:

176: Quite a few children could not make connections between division and multiplication tables, and so struggled on using MAB blocks. The activity went quite well otherwise.

177: Graphs:

178: The graph activity was done quite quickly. Looking at the text pages it was done quite well.

179: 2D Space:

180: The tangram activity was great fun and very challenging.

181:

182: **Week 5:**

183: Revision:

184: Students:

185: Use word problems to revise subtraction to 99 with trading, addition with trading, multiplication and division (done).

186: Revision test (done).

187:

188: **Resources:**

189: MAB blocks

190:

191: **Evaluation:**

192: Revision of subtraction, addition, multiplication and division.

193: Some students are still having trouble with factors and multiples. They forget what they are.

194:

195: **Week 6:**

196: Outcomes: NS2.3; MS2.2; WMS2.3; WMS2.2; WMS2.5; WMS2.4

197: Speed test 3 times table and division facts for 3 times table (done).

198: Number:

199: Multiplication:

200: Students:

201: Square numbers.

202: Use grid paper to make square numbers (done). I'd do this differently the next time, I'd do one number at a time and separately.

203: Text page 72 (done).

204: Multiplication with trading.

205: Using MAB blocks complete p. 50 (done).

206: Estimating and multiplying tens and hundreds using MAB blocks (done).

207: Text p. 80 (done).

208: Measurement:

209: Area:

210: Students:

211: Use overhead transparencies of grid paper to estimate, find and record the area of different shapes in cm^2 (done).

212: Text pages 139, 140 (done).

213:

214: **Resources:**

215: MAB blocks

216: Grid paper

217: p. 207 from Teacher’s Resource Book on overhead transparencies

218:

219: **Evaluation:**

220: Facts practice:

221: Division fact practice is helping get the relationship between multiplication and division clear in children's minds.

222: Multiplication:

223: Multiplication using MAB blocks went quite well. Multiplying by 10 and 100 was quite good, though some students still evidenced confusion.

224: Area:

225: The measurement area activity went quite well. The only problem with this was the symbol for square centimetres (cm^2). Some had a few problems with curved shapes (hands), and how to count part squares.

226:

227: **Week 7:**

228: Outcomes: NS2.3; NS2.4; NS2.5; WMS2.3; WMS2.2; WMS2.4

229: Speed test 4 times table and division facts for 4 times table (done).

230: Number:

231: Multiplication:

232: Students:

233: Estimating and multiplying 1 digit and 2 digit numbers using MAB blocks (done).

234: Text pages 86, 88 (done) some children also did page 89.

235:

236:

237: Number:

238: Fractions and Decimals:

239: Using overhead transparencies of a hundred square construct hundredths and find equivalent number of tenths using MAB blocks (done).

240: Record on numeral expanders (not done).

241: Text pages 30, 31 (done).
242: Measurement:
243: Time:
244: Students:
245: Characteristics of seasons (done).
246: Discuss the rotation of the earth's axis and the resulting seasons (done).
247: Text pages 134 (done), 146 (not done).
248: Discuss a.m. and p.m. (done).
249: Use various timetables and discuss their uses (done).
250: Text page 137 (done).
251:
252: **Resources:**
253: MAB blocks
254: Transparencies of a hundred square (p. 188 of Teacher's Resource Book)
255: Numeral expanders (p. 184 of Teacher's Resource Book)
256: Timetables
257: Overhead of watch faces (p. 203 of Teacher's Resource Book)
258:
259: **Evaluation:**
260: Facts practice:
261: The division facts practice is helping in reinforcing the relationship between multiplication and division.
262: Multiplication:
263: The multiplication activity was quite good as an introduction to vertical multiplication, but there is a long way to go. The estimating was important for helping the children not to play with numbers, but to make sense ("maths makes sense").
264: Fractions and Decimals:
265: More students are seeing the relationship between 10ths, 100ths and a whole - some children are still struggling. The transparency was good as an alternative to the flat in representing the whole.
266: Time:
267: The children generally understand the concepts.

268: The use of timetables stumped a few - they need more experience.
269:
270: **Week 8:**
271: Outcomes: WMS2.1; WMS2.2; WMS2.3; WMS2.4; WMS2.5
272: Speed test 5 times table and division facts for 5 times table (done).
273: Money:
274: Students:
275: Use notes and coins to purchase items in a class shop (done).
276: Text pages 16, 17, 25, 38, 32 (done).
277:
278: **Resources:**
279: Plastic money
280: Items for shop
281:
282: **Evaluation:**
283: This unit went very well. The children really enjoyed playing shops. A real-life activity which was great fun and provided real-life opportunities to use money meaningfully.
284:
285: **Week 9:**
286: Outcomes: NS2.2; MS2.3; WMS2.2; WMS2.3; WMS2.4; WMS2.5
287: Speed test 6 times table and division facts for 6 times table (done).
288:
289: Addition:
290: Students:
291: Model and solve a variety of addition problems to 999 (done).
292: Text pages 78, 79, 81, 82, 87 (done).
293: Subtraction:
294: Students:
295: Model and solve a variety of subtraction problems using trading (done).
296: Text pages 59, 60, 73, 68, 73, 74, 76, 77 (done).
297: Measurement:
298: Capacity:
299: Students:

300: Discuss the need for a millilitre measure.

301: Calibrate a drinking straw (not done).

302: Text pages 136, 141, 142 (done) Completed in Week 10.

303:

304: **Resources:**

305: Plastic money and notes

306: Plastic containers

307: Straws

308: MAB blocks

309:

310: **Evaluation:**

311: Addition and Subtraction:

312: Addition with trading is going very well though many children still struggle with subtraction with trading. For example they commonly make this type of mistake:

313: 41

314: -3

315: 42

316: I might introduce the terms ‘trading up’ and ‘trading down’ to help them. I have encouraged them to work it out in their heads then check their answers so that they don’t make this common type of error.

317: Capacity:

318: Completed in Week 10.

319:

320: **Week 10:**

321: Revision (done).

322:

323: **Evaluation:**

324: Diagnostic tests were completed.

325: Review tests completed.

326: Capacity:

327: This lesson was videotaped.

328: There was not enough equipment for the measurement activity using millilitres. I only had two eye droppers I brought from home. This sort of lesson would benefit from more resources.

329:

330: **Evaluation of Term 3**

331: The Space and Measurement activities are usually okay - resources are often the factor that hinders them being as good as they could be.

332: Sometimes text pages make some of the activities more abstract than they need to be - long-term I would like to address this if I taught the grade again.

333: The operations and associated algorithms are going quite well - but there has been little opportunity for children to develop their own algorithms leading into the need for an efficient algorithm (in fact, the formal algorithm for addition and multiplication was introduced in Year 3). The structure of the program is too time restricted for this. Therefore, many children are following a procedure (some seeing the connection with MAB addition and subtraction) and some are playing with numbers.

Year 4 Mathematics Program, Term 4, 2003

Note: All names except those of my family are pseudonyms.

1: **Mathematics Overview**

2: **YEAR 4 MATHEMATICS**

3: **Outcomes for Term 4** - taken from *Mathematics K-6: Syllabus 2002* *(*Board of Studies NSW, 2002).

4: **Working Mathematically**:

5: WMS2.1: *Asks questions that could be explored using mathematics in relation to Stage 2 content.*

6: WMS2.2: *Selects and uses appropriate mental or written strategies, or technology, to solve problems.*

7: WMS2.3: *Uses appropriate terminology to describe, and symbols to represent, mathematical ideas.*

8: WMS2.4: *Checks the accuracy of a statement and explains the reasoning used.*

9: WMS2.5: *Links mathematical ideas and makes connections with, and generalisations about existing knowledge and understanding in relation to Stage 2 content.*

10:

11: **Numbe**r:

12: NS2.1: *Counts, orders, reads and records numbers up to four digits.*

13: NS2.2: *Uses mental and written strategies for addition and substraction involving two-, three- and four-digit numbers.*

14: NS2.3: *Uses mental and informal written strategies for multiplication and division.*

15: NS2.4: *Models, compares and represents commonly used fractions and decimals, adds and subtracts decimals to two decimal places, and interprets everyday percentages.*

16: NS2.5: *Describes and compares chance events in social and experimental contexts.*

17:

18: **Patterns and Algebra:**

19: PAS2.1: *Generates, describes and records number patterns using a variety of strategies and completes number sentences by* calculating missing values.

20:

21: **Data:**

22: DS2.1: *Gathers and organises data, displays data using tables and graphs, and interprets the results.*

23:

24: **Space:**

25: SGS2.1: *Makes, compares, describes and names three-dimensional objects including pyramids, and represents them in drawings.*

26: SGS2.2a: *Manipulates, compares, sketches and names two-dimensional shapes and describes their features.*

27: SGS2.2b: *Identifies, compares and describes angles in practical situations.*

28: SGS2.3: *Uses simple maps and grids to represent position and follow routes.*

29:

30: **Measurement:**

31: MS2.1: *Estimates, measures, compares and records lengths, distances and perimeters in metres, centimetres and millimetres.*

32: MS2.2: *Estimates, measures, compares and records the areas of surfaces in square centimetres and square metres.*

33: MS2.3: *Estimates, measures, compares and records volumes and capacities using litres, millilitres and cubic centimetres.*

34: MS2.4: *Estimates, measures, compares and records masses using kilograms and grams.*

35: MS2.5: *Reads and records time in one-minute intervals and makes comparisons between time units.*

36:

Reporting Outcomes - taken from *Mathematics K-6* (NSW Department of School Education, 1989):

Number:

- States the place value of digits to 9999
- Solves addition problems mentally
- Solves subtraction problems to 99 with trading
- Demonstrates an understanding of the terms factors and multiples
- Uses known table facts to recall basic division facts to 100
- Tenders the correct amount of money for an item
- Compares and orders tenths
- Records 10ths using decimal form

Space:

- Makes tessellations through flipping, sliding and turning
- Reassembles a 7 piece tangram
- Represents 3D objects through drawing
- Constructs 3D objects from drawings
- Follows directions to complete a maze
- Constructs column graphs

Measurement:

- Records measurements using decimal notation
- Measures surfaces using square metres
- Measures capacities to the nearest 100mL
- Measures the mass of an object to the nearest 100 grams
- Measures and records temperatures in degrees Celsius
- Reads and interprets timetables

68:

69:

70:

71:

72:

73:

74: **TERM 4 PROGRAM**

75:

76: **Week 1:**

77: Outcomes: NS2.3; WMS2.5; WMS2.3

78: Speed test on 6 times table and associated division facts (done).

79: Number:

80: Division:

81: Students:

82: Using MAB blocks complete division problems (done).

83: Introduce division sign (for long division) (done).

84: Text p. 70, 71, 83 (done).

85: **Resources:**

86: MAB blocks

87:

88: **Evaluation:**

89: Division:

90: Students have difficulty with the long division sign. For example, six divided by two is sometimes written six long division sign two. The lack of commutativity in division and subtraction is still a problem for lots of students.

91:

92: **Week 2:**

93: Outcomes: WMS2.3; WMS2.4; NS2.4; MS2.5; SGS2.1

94: Speed test on 6 times table and associated division facts (done).

95: Number:

96: Fractions:

97: Students:

98: Model fractions using MAB blocks (done).

99: Write fractions in decimal form (done).

100: Discuss the use of zero as a place holder in the tenths position (done).

101: Use place value charts to model decimal fractions using MAB blocks (done).

102: Text p. 37 (done).

103: Measurement:

104: Temperature:

105: Students:

106: Explore the use of thermometers using degrees Celsius inside and outside the classroom (done).

107: Discuss the use of centigrade scale and Anders Celsius (done).

108: Order three containers of differing water temperatures using thermometers (done).

109: Monitor temperature changes of cooling water and the effects of the sun (done).

110: Text pages 133, 138, 145 (done).

111: Space:

112: 2D Space:

113: Students:

114: Explore rigid and non-rigid shapes using geo-strips (done).

115: Explore the use of paper to make different 2D shapes (done).

116: Text pages 112, 113 (done).

117: **Resources:**

118: MAB material

119: Thermometers

120: Containers of water

121: Geo-strips

122: Brillex squares and circles

123:

124: **Evaluation:**

125: Fractions:

126: For fractions I used differing shapes divided into 100 pieces to reinforce the concept of a fraction. This went well. This was only started in Week 2 it also went into Week 3. Some students are struggling with fractions in decimals and place value. For example: .5, .05, .50. Using the MAB blocks is confusing when a flat equals one or 100, a short equals one hundredths or one etc. Some children can't make the switch. I am not sure how to address this.

127: Temperature:

128: Students enjoyed the temperature activities. They enjoyed making predictions and seeing if they were true. Seeing the thermometer change was very exciting. Went well.

129: 2D Space:

130: There was a problem with resources for 2D space. There were not enough geo-strips, so I demonstrated this activity making the shapes and passing them around the room. It went quite well and the concept of triangles making a shape rigid went well.

131:

132: **Week 3:**

133: Outcomes: NS2.1; NS2.2; NS2.4; MS2.4; WMS2.2; WMS2.3; WMS2.5

134: Speed test 7 times tables and associated division facts (done).

135: Number:

136: Fractions

137: Students:

138: Use 100s charts to model fractions (done).

139: Use other materials to model fractions (done).

140: Review place value and the use of zero (done).

141: Use place value charts to model decimal fractions using MAB blocks and numbers (done).

142: Text pages 39, 40 (done).

143: Numeration:

144: Number:

145: Students:

146: Use numeral expanders to explore numbers over 1000 (done).

147: Review rounding off (not done).

148: Text page 18, 29, 33, 34 (done).

149: Game.

150: Addition and Subtraction:

151: Students:

152: Write addition and subtraction problems (2 and 3 digit) for the class to solve onto OHP film (solve themselves) (done).

153: Solve other people's problems and share and justify answers (done).

154: Measurement:

155: Mass:

156: Students:

157: Discuss the use of the gram (not done).

158: Explore the use of the kg and g measurement and why different products are measured in one or the other (not done).

159: Investigate the use of grams or kilograms in measuring food items (not done).

160: Text p. 143 (not done).

161: **Resources:**

162: MAB blocks

163: 100s charts

164: Numeral expanders

165: Balance scales

166: Food items (large and small)

167:

168: **Evaluation:**

169: Fractions:

170: This was a follow on from fractions in Week Two. Some children were still having difficulty with 1/10 and 1 hundredth concepts.

171: Number:

172: The number activities were completed later in the week due to my illness (casual teacher).

173: Addition and subtraction:

174: Not enough time for the justification of answers to be worthwhile and always too short. Students have difficulty listening to other children justify. Easily distracted. They need more work in this.

175: Measurement: Mass:

176: No time.

177:

178: **Week 4:**

179: Revision:

180: Outcomes: NS2.3; DS2.1; SGS2.2a; WMS2.5; WMS2.3; WMS2.2

181: Speed test on 8 times tables and associated division facts every day - (done).

182: Number:

183: Division:

184: Students:

185: Using MAB blocks give division problems involving no remainders and remainders and discuss answers using sharing explanation (not done).

186: Use different language to describe division: 60 divided by 2 or share 60 between 2 or 2 into 60 (not done).

187: Text p. 84 (not done).

188: Multiplication:

189: Students:

190: 3 digit by 1 digit numbers (done).

191: Factors and multiples using mystery number game (not done).

192: Problems in grid book (done).

193: Fractions:

194: Review fractions and decimal fractions (done).

195: 2D Space:

196: Graphs:

197: Students:

198: Discuss column graphs and tally graphs (done) Week 6.

199: Look at scales on graphs (done) Week 6.

200: Discuss use of title and key (not done) Week 6.

201: Model process of drawing a column graph - choose a tile, choose a scale, name for each axis, width of columns draw graph with equal space between columns (done) Week 6.

202: Text pages 155, 156 (done) Week 6.

203: 3D to 2D.

204: Students:

205: Make models from drawings using worksheet (not done).

206: Make drawings from 3D models using worksheet (not done).

207: Position:

208: Students:

209: Discuss position on maps. Use atlases and give co-ordinates of places to find (not done).

210: Text pages 114, 115 (not done).

211: **Resources:**

212: MAB blocks

213: Atlases

214:

215: **Evaluation:**

216: Revision:

217: This week was used for revision. Therefore regular programming was not followed.

218: Using overheads, I allowed time to complete questions and went through them as a whole class. This was very teacher directed.

219: Graphs:

220: (Graphing from this week was eventually done in Week 7 while catch-up done individually on assessment for reporting).

221:

222: **Week 5:**

223: Exams: (done).

224:

225: **Evaluation:**

226: Exams finished. It was a tiring experience for the students. Number exam - Monday, Measurement - Tuesday and Space - Wednesday. Not all students were present for all exams so that has to be caught up too.

227:

228: **Week 6:**

229: Revision from exams (done).

230: Outcomes: NS2.3; MS2.2; WMS2.3; WMS2.2; WMS2.5; WMS2.4

231: Speed test 8 times table and division facts for 8 times table (done).

232: Number:

233: Multiplication:

234: Students:

235: Problem solving using multiplication and MAB materials (done). in Week 7.

236: Introduce algorithm (done) in Week 7.

237: Text page 91 (done) in Week 7.

238:

239: **Resources:**

240: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

241: *What's your problem?* (Skinner, 1990)

242: *It all adds up* (Skinner, 1998)

243: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

244: MAB blocks

245: YEARLY EXAMS RESULTS AND ASSESSMENTS WILL DETERMINE REVISION FOR THE NEXT 3 WEEKS

246:

247: **Evaluation:**

248: Multiplication:

249: Not completed due to assessment and revision.

250: Assessment:

251: Assessment of outcomes for reporting was a priority this week. We looked at exams as a class so students could clarify their understandings (Children keen to do this).

252: Graphs:

253: Graphing tasks from last week were done and students were withdrawn for assessment tasks (gms, 3D, m^2) if they had not been previously assessed in class time.

254:

255: **Week 7:**

256: Outcomes: NS2.3; NS2.4; NS2.5; WMS2.3; WMS2.2; WMS2.4

257: Speed test 8 times table and division facts for 8 times table (done).

258: Revision and problem solving using:

259: *What's your problem?* (Skinner, 1990)

260: *It all adds up* (Skinner, 1998)

261: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994) (not done).

262: Multiplication and division:

263: Factors and multiples.

264: Measurement:

265: Space

266:

267: **Resources:**

268: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

269: *What's your problem?* (Skinner, 1990)

270: *It all adds up* (Skinner, 1998)

271: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

272:

273: **Evaluation:**

274: Revision:

275: We revised division this week based on assessment and exams I felt it needed doing. We looked at the multiplication and division algorithm. Completed pp. 84, 90, 91 in the textbook and gave challenges e.g. 5) ??=3r2. I used magnetic MAB and overheads to mark and demonstrate answers. Division page from a resource book was also used.

276:

277: **Week 8:**

278: Outcomes: WMS2.1; WMS2.2; WMS2.3; WMS2.4; WMS2.5

279: Speed test 7 times table and division facts for 9 times table (done).

280: Revision and problem solving using open-ended mathematics activities (done) but not using these resources - sheets from other Year 4 teacher used.

281: Using the following resources:

282: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

283: *What's your problem?* (Skinner, 1990)

284: *It all adds up* (Skinner, 1998)

285: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

286:

287:

288: **Resources:**

289: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

290: *What's your problem?* (Skinner, 1990)

291: *It all adds up* (Skinner, 1998)

292: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

293:

294: **Evaluation:**

295: Revision:

296: Revised m^2 using sheet from a resource book. Revised gms and kgs. Problem solving lesson videoed.

297:

298: **Week 9:**

299: Outcomes: NS2.2; MS2.3; WMS2.2; WMS2.3; WMS2.4; WMS2.5

300:

301: Revision and Problem solving using:

302: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

303: *What's your problem?* (Skinner, 1990)

304: *It all adds up* (Skinner, 1998)

305: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

306:

307: **Resources:**

308: *Open-ended Maths Activities* (Sullivan & Lilburn, 1997)

309: *What's your problem?* (Skinner, 1990)

310: *It all adds up* (Skinner, 1998)

311: *Thinking mathematically* (McIntosh, De nardi & Swan, 1994)

312:

313: **Evaluation:**

314: No set mathematics lessons this week - no longer meeting in mathematics groups. Mathematics activities and sheets are part of Christmas book.

315:

316:

317: **Evaluation of Term 4:**

318: A lot of this term has been taken up with reporting. Week 4 - revision. Week 5 - exams. Week 6 - going over exams and assessing for outcomes that need observation and have not yet been completed. I tried early in the term to do assessment observations but could not get through them, so I have continued to do this throughout the term. Weeks 7 and 8 were revision based on exam and assessment results.

Year 4 Mathematics Diary, Term 1, 2003

1: **Note**: All names except those of my family are pseudonyms.

2: Key: To roles in the school.

3: Pseudonyms:

4: Gabriel = Principal.

5: Dallas = Deputy.

6: Robin = Stage 1 Coordinator.

7: Caz = Stage 2 Coordinator for Term 1.

8: Sidney = Stage 2 Coordinator for remainder of the year (not teaching on the Stage).

9: Dannie = the other Year 4 teacher.

10: Alex = STLD teacher.

11: Chris = G & T teacher.

12: Ronny and Rani = Year 3 teachers.

13: Jeri = Year 6 teacher.

14: Maxie = Year 5 teacher.

15: Jackie = Principal's secretary.

16: Meredith = School Counsellor.

17: Glenn = IT administrator.

18: Bobbie = Year 2 teacher.

19:

20:

21: Not pseudonyms:

22: Wal = My husband.

23: Simone, Matthew, Priyani, Elise = My children.

24: Tom = Simone's husband.

25:

26:

27:

28:

29: **Diary**

30: Tuesday 14.1.03

31: 8 p.m.: Caz's place.

32:

33: Wednesday 15.1.03

34: 12.30 p.m. specialist appointment for Elise.

35:

36: Monday 20.1.03

37: 8.20 a.m.: cast off

38: 2.45 p.m.: Elise’s medical appointment.

39:

40: Tuesday 21.1.03

41: 9.45 a.m. Orthopaedic Surgeon appointment.

42:

43: Wednesday 22.1.03

44: Elise's medical tests.

45:

46: Saturday 25.1.03

47: Uni meeting.

48: Elise's birthday celebration dinner.

49:

50: Sunday 26.1.03

51: Uni meeting.

52:

53: Monday 27.1.03

54: I’m starting school tomorrow feeling totally unprepared and recovering from a badly broken foot (8.12.02). I only had the plaster removed last week (20.1) and I could not put any weight on it. I had to see the physio on (23.1) and I told him I didn't know how I was going to start school, he gave me a rigid boot to wear (a bit like a cast), it made all the difference. I still need crutches but I can put weight on it, so the crutches just helped to support me.

55:

56: I went to school, after having the plaster removed to organise a few things (for me and Elise, who is starting there for Year 11) and I had to use a walking frame (because I fall over all the time on crutches) and I could not put any weight on my foot. I could see the shock on Gabriel's face when she saw how immobile I was. I told her I would need to park as close as possible to my room (the disabled spot is the closest) and she was fine with that. She wanted reassurances that I would be okay to start, I gave them, but I must admit I was not feeling confident.

57:

58: The week before I had my cast off (14.1) all the Stage 2 teachers were invited to Caz's home for supper with their spouses, very nice, but I could see her concern when I needed a walking frame to get a round. Anyway the boot has made a big difference, the pain is excruciating without it, in fact I still can't put weight on it, but bearable with it. My foot is so swollen and sore, I still need to protect it. I have decided to use a wheelchair in large crowds (assembly, quadrangle at lunch etc.) and crutches and a walking frame to lean on in the classroom.

59:

60: I have not been able to do a lot in preparation for teaching, Caz dropped around a previous teacher's program and I suspect I will depend on it a lot to start with. Programs are due in Week 5. Until I can check out resources at school I can't really do my program.

61:

62: Wal, Priyani and Elise all came to school with me yesterday and cleaned out the room, helped move furniture and organise the room, they were great. The girls also helped me buy a few things (rewards etc.). I am nervous about tomorrow.

63:

64: Wednesday, 29.1.03

65: We have had two days of meetings, whole school, primary and Stage meetings. I found it frustrating because I feel so under-prepared to start teaching tomorrow and I needed more time to get myself and my classroom organised. Just getting equipment, books and stationery is such an effort at the moment. I can't get up to the staffroom for lunch or recess unless I drive (which I've done a bit these two days), the stairs and hill are impossible for me to manage.

66:

67: I have had a personal problem as a parent (Elise is to attend Year 11) with Gabriel. The school uniform is a skirt for girls, and she has a health condition which makes her legs go blue. We tried the uniform at the shop last weekend and she just can't wear it, her legs were almost purple, she was crying hysterically. We bought a pair of skin coloured support-style stockings and put them on with socks over the top and she looked dreadful. Anyway I had rung Gabriel and explained the problem and she came to see me at school today saying she'd thought about it and wanted her to wear stockings and socks with the skirt to avoid problems with other girls (she gets complaints already about not having slacks available for them). I rang Elise and she cried hysterically on the phone, and I decided, boss or not, I could not do this to her, she would have to change schools if they couldn't accommodate her. I got off the phone from her and rang Gabriel (up the hill), and told her that Elise had to wear trousers. She reluctantly agreed, but said she wanted veto on style (high waisted). I got off the phone and sobbed, Elise is contemplating a possibly fatal condition and really struggling with the appearance of her legs (she now only wears pants) and she and I don't need this rubbish. If I wasn't a staff member I would be tempted to kick up a stink at the sexism of the 'no pants' uniform policy anyway. Anyway I've calmed down now. Jeri walked into my classroom when I was having a cry and she was very kind and supportive.

68:

69: We were given the afternoon off meetings today to do personal preparation and I felt I hardly knew where to start. I wrote down the day plan for tomorrow (just a skeleton of possible things to do) so that I at least have enough to fill the day. There is so much I don't know and I feel a little like my head is spinning and I can't get a handle on everything, out-of-control I guess. My day plan is my little bit of control.

70:

71: I am so nervous too about hurting myself in the crowds of children tomorrow, I'm glad I have organised to have a wheelchair in the classroom. I don't know how I would cope otherwise. As it is I have to drive to Jackie's with Wal to drop it to her and she is taking it for me to school. Gabriel has agreed that I do not have to attend morning staff meetings, because of the difficulty of getting to the staffroom. I don't know how long that will be for.

72:

73: To do: Get recording equipment tagged before use in the classroom.

74: Get a set of school magazines for English.

75:

76: 4.30: Uni meeting.

77:

78: Thursday 30.1.03

79: I had a great start with the children. I think they were really kind to me, starting school in a wheelchair certainly gets the sympathy vote. The wheelchair worked well in protecting my foot, but walking around on it all day is so painful and tiring. My foot is so swollen and sore tonight. I am exhausted.

80:

81: I was given some background information on my students from Caz who had a lot of them last year. I worked out my seating plan based on that, as I didn't know where else to start. A lot of it was just potluck, but I was concerned to put Desi (quite severe learning difficulties) with someone who could help him, so I put him with Billie who Caz said is quite gifted and a lovely child. A few of the children I placed away from each other because of the things I was told by Caz, and I put Desi and Brooklyn near the front for eyesight reasons. I will review the seating when I know the children better.

82:

83: My playground duties are all in the library, which is great (they have been very kind to me) because I could not possibly navigate a playground in my current state.

84:

85: To do: Plan for the tomorrow.

86: Photocopy "Who am I?" sheets - 30.

87: Work out books I will need for the class (talk to Dannie).

88: Get rewards system organised.

89:

90: Friday 31.1.03

91: The "who am I?" competition went well, the children love sharing their baby photos and having people guess who they are. We've had no time for mathematics yet.

92:

93: Another good day, generally, but I was a little surprised to see Billie’s body language with Desi (he seems to turns himself away from Desi’s side of the table, almost puts his back to him) and have had Desi come to me at lunch and ask me if he could sit somewhere else because Billie didn’t like him. I took Billie aside and asked him if there was a problem, but he insisted he was fine, I reassured Desi and he seemed to be OK. I will watch it.

94:

95: Paris is a handful, very organising and talkative, I need to be on my toes with him. I am getting to know the children’s names, although there are a handful of blond haired children who I have trouble distinguishing from each other. I’m sure it will come soon.

96:

97: To do: Plan for the week.

98: Look at the resources available.

99: Laminate bookmarks.

100: Work out books I will need for the class.

101: Fix up whiteboard for magnet rewards system.

102: Take in grandmothers’ photo for sharing how my family came to Australia.

103:

104: Saturday 1.2.03

105: Well it's started, it went quite well. Very busy, lots of organisation/starting school activities. The class seem quite lovely. A good start behaviour management wise. There is so much I haven't got a handle on, I wish I had my program up and running.

106:

107: Groups for mathematics and English won't start until Weak 3, we will do testing, look at last year's results, and Chris and Alex will do assessments to finalise all that. I am taking the upper mathematics and lower English group, which suits me, I have STLD experience in reading support so I like that. Mathematics I don't mind either way. My first priority is getting my programming under way. Dannie is great, in that she is very helpful, but has only been on class for one term having changed schools, and she hasn't taught Year 4 before either. Caz is supportive but I just don't have everything I need, and don't even know what I need in some ways. Knowing what I need would be a great start.

108:

109: I have no personal resources to support teaching this grade. Chris taught this Stage and Dannie has a cupboard full of her resources (lucky her), I'll go in and look to see when I have time.

110:

111: My foot is so painful and tiring. I am exhausted at the end of the two days, I really need to pull my foot up and recover, but I know I have a lot to do. I've decided to eat lunch and recess in my room, I can't drive from the classroom to the staffroom, my time would be up before I got there, I am so slow.

112:

113: Wal and Matt fly to Sri Lanka today for two weeks, I am nervous for Matt.

114:

115: Monday 3.2.03

116: 3.30 p.m. - 5 p.m. Stage Meeting.

117: To do: Get Unifix cubes.

118: Get hundreds charts/counters for tomorrow.

119: Ring university supervisor about re-enrolment.

120: See librarian to organise bulk loan from the library for Silent Reading.

121: Make Assembly book.

122:

123: Tuesday 4.2.03

124: The past two days have been good. Still working in home class groups, testing etc. I have continued to watch the Billie and Desi situation and decided today to take Desi aside and ask who he would like to sit with. He asked to sit with Drew, which I organised. I said nothing to Billie but I was disturbed by his attitude to Desi and how this was made plain to Desi without being openly rude. There was nothing specific to talk to Billie about, but when I watched him carefully he was more than just unconcerned with Desi he wanted Desi to know it. This doesn't gel with the type of child Caz prepared me for. I spoke to the class today reminding them of our class rules which come down to 'respect' and showing this to each other. I reminded them that this means treating others the way we like to be treated.

125:

126: Desi has had a lot of problems in the past settling into a new classroom. I think I am building a warm relationship with him, he seems outwardly comfortable anyway. He has a lot of difficulties with reading (he is intellectually disabled), he is a pleasant child and will tell me if he has a problem, or so it seems.

127:

128: To do: Organise bulk loan (see librarian).

129: Organise speed test booklets.

130:

131: Wednesday 5.2.03

132: To do: Organise bulk loan (see librarian).

133: Organise speed test booklets.

134:

135: Thursday 6.2.03

136: 4:20 p.m. physio.

137: To do: Organise bulk loan (saw librarian, I need to select them myself or it will be weeks before she can help).

138: Organise speed test booklets (found BLM book, organise photocopying).

139: Merit awards

140:

141: Saturday 8.2.03

142: 11 a.m. physio.

143: 8 p.m. Balmoral Beach, Elise's drama.

144:

145: Sunday 9.2.03

146: I'm finding it hard to find time even for this. I am going to the physio twice a week after-school and I am programming at every opportunity. At school I am marking, locating resources, trying to work out what I need to know and talking with others.

147:

148: I am up nearly every night to 10.30-11 p.m. I start work straight after dinner, with a laptop on my lap and my foot elevated. When I don't have to go to the physio I either bring Elise home at 4 p.m. and do some work before dinner too. This is either preparing for the next day or programming and marking. I am finding it hard to bring home stuff to do because of my mobility, but Elise is a help. I had an afternoon sleep today to try and catch up. Still worked into the night yesterday and today (Elise went to the drama last night with a friend).

149:

150: I want to get my room looking better (children's work displayed and posters up), I don't know when I can do this as I can't get up to hang things up and time is an issue.

151:

152: Matt's birthday in Sri Lanka today, I rang and spoke to him.

153:

154: Monday 10.2.03

155: 3.30 p.m. - 9 p.m. Parent/Teacher interviews.

156:

157: Parent/Teacher interviews were fine. No complaints, mainly introducing myself and hearing of their concerns about anything to do with their children. Relationship issues were raised by some parents (children having problems with others) and learning difficulties were talked about by other parents. Assurances were given on all fronts, especially regarding no tolerance of bullying.

158:

159: To do: Get aboriginal artefacts for HSIE unit.

160:

161: Tuesday 11.2.03

162: To do: Hand out book covers.

163:

164: Wednesday 12.2.03

165: To do: Hand out book covers.

166: Photocopy "magnet" booklets.

167:

168: 7.45 p.m. Education Committee (from other school) Meeting here.

169:

170: Thursday 13.2.03

171: Swimming Carnival, I did not attend the Carnival all day due to Elise's tests, but I was there for most of it.

172:

173: Saturday 15.2.03

174: Wal and Matt back from Sri Lanka, we all picked them up from the airport.

175:

176: Sunday 16.2.03

177: This was a big weekend personally due to Wal and Matt's return - talking, photos, gifts etc. Wal and Matt are both really sick with heavy colds. It'll be nice to have Wal back in a lot of ways, but sharing family roles will be great.

178:

179: I'm still programming, so much to do. Homework started this week, children have two homework books to allow time for marking (this is what the previous teacher did). Dannie and I are taking turns to make up a homework sheet. She did this one.

180:

181: Monday 17.2.03

182: 3.30 p.m. - 5 p.m. Staff Meeting.

183:

184: To do: Make a note requesting parent assistance.
185: Make homework sheet.
186: Make activity sheet for magazine.
187: Ask Dannie about English sheets.
188: Look for "Decisions" support resources.
189: Get resource books on dinosaurs.
190: Photocopy worksheets for magazines.
191:
192: Tuesday 18.2.03
193: To do: Get hundreds charts.
194: Photocopy homework sheets, roster, behaviour chart, pre-test pro-forma.
195:
196: 6.20 p.m.: Physio
197:
198: Wednesday 19.2.03
199: I spoke to Caz today about needing to take a day off. There is so much to do (in terms of programming and just preparing for each day) and I am in agony with my foot all-day, it feels like it is on fire, so swollen and sore. The boot is a great help, it keeps me mobile (and boy do I need to be!!) but I am so tired and in constant pain. Caz was very understanding, so I organised to take Friday off and literally put my 'foot up'. I no doubt will use the time to program.
200:
201: To do: Get Assembly book to Dannie.
202:
203: Thursday 20.2.03
204: To do: Make sheets for HSIE explorers.
205: Merit awards.
206: Complete homework sheet.
207:
208: 6 p.m.: Physio.
209:
210: Friday 21.2.03

211: Casual in to replace me. I left work for her, and she appears to have completed it all.

212: I slept for most of the morning and programmed for most of the afternoon and evening.

213:

214: Sunday 23.02.03

215: I programmed for about 10 hours on the weekend, my program is beginning to look like it would choke a horse. I marked homework, making a homework checklist, because it has become apparent that some children are not completing their homework. Tonight I have written up my day book for the week. Not everything is in it, but it gives me structure.

216:

217: Monday 24.2.03

218: 3.30 p.m. - 5 p.m. Stage Meeting.

219:

220: To do: See Dannie - program.

221: Make up roster for reading group mums.

222: Look for spelling worksheets.

223: Write apostrophe sheet.

224: Photocopy: Homework sheets – 65.

225: Apostrophe sheet.

226: Mathematics tests.

227: Aboriginal pictures.

228: Health sheets pp. 15 and 19.

229:

230: Tuesday 25.2.03

231: Handed my program in today!! It was given back to me until the weekend when Caz will have time to look at it.

232: To do: Get hoops, bean bags.

233: 7.30 p.m. HSC meeting for Elise.

234:

235: Thursday 27.2.03

236: To do: Get equipment for chapel groups tomorrow - glue, something about friends.

237: Merit awards.

238:

239: Monday 3.3.03 Midterm Break

240: Hallelujah! I handed in my program last week. What a huge job - so much in it. So glad to give it to Caz. I know I'm not the only one feeling this way - Dannie, for one, was overwhelmed as was Ronny (Year 3). Caz was the only one on our Stage who has taught her grade before. BIG JOB!!

241:

242: I took the weekend off - lovely! Caught up on sleep and had a bonus day today. I have written up my day book tonight, with gaps, and typed up a homework sheet. Caz has my program. But I feel more relaxed now.

243:

244: Tuesday 4.3.03

245: I got my program back today - lovely comments e.g. "exceptional", "professional", "excellent" and "fantastic". So I am chuffed and relieved, nothing needed changing.

246:

247: To do: Get Angles kit.

248: Get English sheets.

249: Photocopy: Homework sheets.

250: Apostrophe sheet.

251: p. 13 of Word book.

252: Organise devotions/assembly.

253:

254: Wednesday 4.3.03

255: To do: Get overhead projector.

256: Organise assembly.

257: Get Angles kit.

258: Fix up signs and put up.

259: Photocopy groups list.

Laminate group list and put up on wall.

4.15 p.m. Orthopaedic surgeon appointment.

Thursday 6.3.03

To do: Photocopy p. 3 of magnets - 30.
Organise assembly.
Organise for chapel group.
Make homework sheet.
Merit awards.

Sunday 9.3.03

Uni meeting.

Monday 10.3.03

3.30 p.m. - 5 p.m. Staff Meeting.

To do: Get origami book from Dannie.
Equipment for compass; corks, needles, bowls?
Look for "*Fantastic Mr Fox*" resources. (Dahl, 2001)
Get Draft books.
Get cones, hoops, bean bags.
Get Teachers Resource Book for mathematics Textbook.
Photocopy: First Fleet sheets.
Homework sheets – 65.
Mathematics BLM 185, 182.

Wednesday 12.3.03

7:45 p.m. Other school board - membership meeting.

Thursday 13.3.03

To do: Get procedure chart.
Get magnets stuff.
Mark handwriting.

294: Merit awards.

295:

296: Friday 14.3.03

297: To do: Get frieze up on wall.

298: Hang up origami.

299:

300: Sunday 16.3.03

301: Feeling down - consumed by teaching (which is tiring in itself) and preparing, marking and organising room. (Today Wal came to school to help hang up origami, I began on Friday with Elise's help but still more to do. The children loved the activity and the frieze is looking great!). Always something to do.

302:

303: People have been nice, but I feel a little ‘hurt’ that I spend my recess and lunch in the classroom, because I can't get up to the top to the staffroom and no one has thought to say to Stage staff at least, "let's eat with Tricia". I see the library staff get-together in my building occasionally, I joined them once, and I pop in and out to get my stuff from the refrigerator in the librarian's office. I feel Caz, at least, should have given it some thought. Now I feel like a whinger. I'm not going to say anything, but it isn't great staff support, from above, and not very thoughtful from my peers.

304:

305: Monday -17.3.03

306: 3.30 p.m. - 5 p.m. Stage Meeting.

307:

308: I’m sick with a cold, taking medication.

309: Getting ready for a casual tomorrow (Elise's tests) was huge. Photocopying a poem each, Divinity sheet each and checking for convict search. I was at school until 6 p.m..

310: I didn’t take work home which was great (today) but Sunday night I was up until after midnight, after working at school for a couple of hours with Wal.

311:

312: Tuesday - 18.3.03

313: Away today with daughter's tests.

314: A friend did the teaching today.

315: I did nothing at home, which was great!

316:

317: 7:30 a.m. St George's Hospital

318: 10:45 a.m. Skin specialist at Castle Hill.

319:

320: Wednesday 19.3.03

321: To do: Get equal arm balances, kilo weights, things to weigh.

322: Get hoops, bean bags.

323:

324: Gave apologies for board meeting at the other school, too much to do, not feeling well and can't cope with the late night out.

325:

326: Thursday 20.3.03

327: To do: Merit awards.

328: Make Homework sheets.

329:

330: The HSIE unit on the British colonisation of Australia has been fascinating. The children were going to do poems for Talking and Listening, but we have voted today and agreed to present our convicts (from the computer searches) in our news time instead, until the end of term.

331:

332: I was not 100% today so I did money rather than capacity with water. We completed two pages of text - one on combinations of coins and totals, one on giving change. Both were completed well. We had one open-ended question at the end (I have $1.60 - 3 coins in my pocket what are they?) and that went well but we ran out of time.

333:

334: I am exhausted at the moment with a cold. I marked English Draft Writing books last night - one and a half hours. My biggest frustration at the moment is the number of children who do not finish tasks or complete set things at home e.g. title pages.

335:

336: We had a vote about our talking and listening activity. We were going to do poems, but agreed to present the convicts we researched instead of news until the end of term.

337:

338: Friday 21.3.03

339: Ladies night away tonight with church.

340:

341: Sunday 23.3.03

342: I am unwell and finding it hard to cope. I have homework and handwriting to mark as well as writing up next weeks lessons. I am so tired that I don't know how to do it. I'm more than tired, I am sick of doing this all the time, I feel like I have no life. When I'm not doing school work I'm feeling guilty. There is so much to do. I don't feel that I'm teaching well, just basically, no time for thorough planning and preparation. Dannie said that a long-time teacher friend advised her that she plans and teaches one good lesson a day, and 'makes do' on the rest, as anything else is impossible. I think it might be good advice and when you're experienced the 'making do' might be better. I feel that I don't have time for even one 'good' lesson. I feel I have fallen short of teaching the content of British Colonisation. Just reading the facts is a big task, which I am attempting just before the lesson, or even as I teach. I know I would do it better second or third time around and that is the great bonus of experience.

343:

344: I have done less night-time work this week due to illness, but tonight I have written up my day book for next week.

345:

346: I went on the Ladies night away, reluctantly, all a bit much the moment, but it was nice when I got there, but getting there felt more like a burden than a pleasure.

347:

348: Monday 24.3.03

349: 3.30 p.m. - 5 p.m. Staff Meeting.

350:

351: Pen licences given to six children today some upsets.

352:

353: To do: Get on the Internet for "*Fabulous Mr Fox*" activities.

354: Look at pp. 52 and 59 of mathematics textbooks for ideas.

355: Computing assignment.

356: Photocopy: First Fleet crossword if necessary and overhead.

357: Computing assignment.

358: p.5 of magnets.

359: Pretests.

360: Homework sheet - 65.

361: Get copy of book from Meredith.

362:

363: Tuesday 25.3.03

364: A student's mother was so helpful marking spelling tests and listening to reading.

365:

366: I had to get ready for a casual tomorrow, to attend my Aunt's funeral (took me about 45 minutes).

367:

368: Caz came to me today saying Billie's mother had said that Billie is unhappy because he is bored. I suggested this may have something to do with social problems. I will talk to Billie and mum.

369:

370: 5 p.m. Physio.

371:

372: Wednesday 26.3.03

373: I did not teach today - I attended funeral.

374:

375: Thursday 27.3.03

376: To do: Merit awards.

377: Make homework sheets.

378:

379: Spelling groups went well - they were capable of working out the family words themselves.

380:

381: Due to a different school routine today there was only one hour of English, which was spent doing thinking activities run by Chris for G & T program.

382:

383: I spoke to Billie today. There is so little time to be bored as he said he was happy in English/mathematics/S & T (magnets unit)/HSIE(convicts)/Art/Music and we haven't done PDH/Craft that we agreed he would come to me if any boredom happens.

384:

385: I asked if he was happy and it came out that he was upset by friendships and bullying activities. I told him I would talk to the children involved. He is also upset about not getting his pen licence.

386:

387: Paris should have been on lunch detention but was with Caz instead.

388:

389: Friday 28.3.03

390: I have really been struggling health wise. I had a lot of trouble with three groups of children having relationship problems. Took 25 minutes of lunchtime to deal with.

391:

392: I rang Billie's mum tonight and it went well. She was oblivious to the relationship problems.

393:

394: Paris in for the whole lunch.

395:

396: Caz's resignation advised today.

397:

398: To do: Get HSIE video.

399:

400: Saturday 29.3.03

401: 1:30 p.m. interviewing as a board member for staff at another school.

402: 8 p.m. Wal took Elise to see a play for school.

403:

404: Sunday 30.3.03

405: I feel really disappointed with my efforts in mathematics teaching. I am doing OK in Space and Measurement because the text pages are 'hands-on' and OK. But I have done little more than text motivated number units. I am learning outcome expectations as I go - children's thinking etc. and I am not confident with trading.

406: E.g. I gave vertical problems and asked children to work out the written algorithm and teach it to the class (students already familiar with the set written algorithm). That went OK but I don't know all of the possibilities that come out of this sort of thing and I get thrown.

407:

408:	32 -	47 -	186 -
409:	<u>6</u>	<u>8</u>	<u>9</u>

410:

411: The first 2 were OK but the third was an extension and I had trouble explaining trading when I quickly addressed it at the end. It's the first time I've had to think of it and I will be better prepared for this problem next time.

412:

413: I am finding that there is so much to prepare for that only a very cursory preparation for each lesson is possible in all subjects.

414:

415: I am having Caz watch a lesson on Monday. I am nervous, and will have to plan more.

416:

417: I went in to work today for one and a half hours to organise classroom.

418:

419: Marking handwriting, homework and planning next week tonight.

420:

421: Monday 31.3.03

422: 3.30 p.m. - 5 p.m. Stage Meeting.

423:

424: Caz watched me teach HSIE today - it was on the uses of magnets in every day life. I did a good lesson and had excellent feedback - but I spent more time on it that I do usually because there just isn’t the time to be this prepared all the time.

425:

426: To do: Get new book "*Matilda*"? for shared reading (Dahl, 2002).

427: Mathematics; see how Position goes before planning tomorrow.

428: Get the addition pages from the textbook.

429: Ask Bobbie about the stained-glass craft.

430: Get magnets books from the library.

431: Photocopy: pp. 6 - 7 of magnets sheets.

432: Divinity worksheets.

433: Health 4, p.19 "Decisions".

434: Homework sheets - 65.

435:

436: Tuesday 1.4.03

437: 5:45 p.m. Had physio today. Took in new sneakers to be fitted with orthotics (they've now been ordered). I will speak to Gabriel tomorrow about the need to wear these sneakers to school every day for months.

438:

439: Wednesday 2.4.03

440: I spoke to Gabriel today, she was fine about shoes.

441: To do: Get video for English.

442:

443: Thursday 3.4.03

444: I videotaped the mathematics today.

445:

446: To do: Merit awards.

447: Pick up recording equipment from uni.

448: Photocopy p. 6 of magnets sheets - 30.

449:

450: Sunday 6.4.03

451: I went to the camp site this afternoon (travelled with Ronny) to meet with Staff and parents to prepare families for Stage 2 Camp next term. It was fine, but it took 4-5 hours of the day. I still had to come home and prepare for the week. Even having two homework books I am finding it hard to get it marked to get back. Handwriting books, mathematics textbooks, English books, all KLAs have marking and it gets out of hand. I need to manage this better. I find it hard to mark as children work, too many distractions, only get a handful done most times. Getting children to mark their own only works for some things, so I can't get around the need to do the marking. But I think I will have to get children to mark the Mentals textbook (homework) in class. I can't see how they'll help with a lot of the other. I spend a lot of time after school to try and avoid bringing it home, but that doesn't always work.

452:

453: Monday 7.4.03

454: 3.30 p.m. - 5 p.m. Staff Meeting.

455:

456: To do: Get video for HSIE.

457:

458: Tuesday 8.4.03

459: To do: Write up poem overhead.

460: Photocopy "*Fantastic Mr Fox*" (Dahl, 2001) activity sheets - 30.

461: Return library books, including bulk loan.

462:

463: 5:20 p.m. Physio today, orthotics fitted.

464:

465: Thursday 10.4.03

466: To do: Merit awards.

467:

468: Friday the 11.4.03

469: To do: Clean up the classroom.

470: Gets children to clean out tote trays etc.

471: Clean desks.

472: Take books back to library.

473:

474: Most children went home at 1:05 p.m., the remainder watched videos in the library, while the teachers marked work, while supervising them.

475:

476: Saturday 12.4.03

477: Holidays!! Well it's over and I feel like I survived. I am exhausted physically and sick of doing school work. It seems to have consumed my life. I need to have some time off, but I hope to start programming in the second week of the holidays to alleviate some pressure when school starts. The pressure isn't just the programming, but working out what to teach when the program isn't complete - this adds stress to the busyness. Anyway, I'm not going to think about it this week and I'm going to enjoy convention next weekend. I've only got Elise's appointment with the haematologist to deal with. I'm going to do a lot of sleeping this week - maybe watch a DVD or two. My foot will really appreciate it!

478:

479: **Action Research focus:**

480: It has become very obvious that my main focus this year in mathematics will have to be coming to terms with the Year 4 content and trying to identify associated student thinking. I will try to incorporate non-routine questions into my lessons and provide group learning activities and class discussion, but they cannot be my main focus. I can see I will not have enough time to thoroughly prepare for these things like I did in Year 2 last year, when I am not satisfied with my mathematics content knowledge in all areas (I don’t know what I don’t know). I think I know the content and something will come up in a child’s question or in my need to explain something that shows me I need to be more familiar with it (e.g. in the use of the subtraction algorithm I came a cropper when I introduced a question with 0 in the tens column and the units column, I was unsure of how to demonstrate trading, I really had to think it through and practise all sorts of possible questions to be comfortable with it.

Year 4 Mathematics Diary, Term 2, 2003

Note: All names except those of my family are pseudonyms.

1: Sunday 13.4.03

2: Wedding Anniversary.

3:

4: Tuesday 15.4.03

5: 1:30 p.m. Elise's appointment with haematologist at St George Hospital.

6:

7: Friday 18.4.03

8: Easter convention.

9:

10: Saturday 19.4.03

11: Easter convention.

12:

13: Sunday 20.4.03

14: Easter convention.

15:

16: Monday 21.4.03

17: Easter convention.

18:

19: Sunday 27.4.03

20: School starts again tomorrow, I have had a break but I am still not ready to face the term. I did a couple of days sorting out programming but didn't achieve a lot. I've worked tonight on planning the week without a really good handle on the Term, but some things just continue e.g. "*Matilda*" (Dahl, 2002), mathematics tests etc. This term is going to be huge with programming, reporting and camp.

21:

22: **Term two**

23: Monday 28.4.03

24: Staff Day

25: Elise had an appointment with the heart specialist at Wahroonga at 2:45 p.m., I was only at school until 1 p.m.

26:

27: Tuesday 29.4.03

28: Staff Day

29: 5:40 p.m. Physio.

30:

31: Wednesday 30.4.03

32: Billie came into class crying and saying he is sick. I questioned him about any problems and he told me he was going to doctors and he's been sick all holidays. He went home.

33:

34: To do: Ask Dannie about HSIE outcomes. Organise assessment.

35: Photocopy: Multiplication tables speed tests.

36: Review sheet for S & T.

37: Get card template.

38: Organise HSIE review - a letter home to England.

39: Take in bag for news demonstration.

40:

41: Thursday 1.5.03

42: Billie not in.

43:

44: Friday 2.5.03

45: Mother's day card very effective and children loved them.

46:

47: Saturday 3.5.03

48: I spent about 10 hours preparing medical data base for Camp and ringing parents for details that weren't clear on forms. A big job - I would do it more simply next time.

49:

50: Monday 5.5.03

51: 3.30 p.m. - 5 p.m. Stage Meeting.

52:

53: The mother’s day card was a lot of work for me - because of A-drive problems and having to trouble-shoot for the children. I approached it by having half do the dog pop-up bit and the other half on the computer and swapped - two hours of time. I spent all first half of lunch printing. I spent all of the next lunch setting up for children but A-drive problems made it hard.

54:

55: Billie came in upset and was brought to class by Dallas crying - Dallas saying Billie bored.

56:

57: Lunchtime Stage meeting to organise the Camp.

58:

59: To do: Organise a library loan.

60:

61: Tuesday 6.5.03

62: Billie crying again - late to class he was in Robin’s class upset when dropped off to school.

63:

64: Mother's Day stall today interrupted our mathematics lesson.

65:

66: We had a Camp assembly this afternoon, to make sure the children are clear on what to do and what to expect.

67:

68: To do: Photocopy multiple activity book sheets for children who have finished their cards, while I help those who haven't finished them.

69: Pack for camp.

70: Write up Day Book for next week.

71:

72: Wednesday 7.5.03

73: Camp.

74:

75: Thursday 8.5.03

76: Camp.

77:

78: Friday 9.5.03

79: Camp.

80:

81: Saturday 10.5.03

82: Camp went well though Billie went home upset (from camp), being very upset when he came to school (before camp and being persuaded to go). I had a good talk to him for about one hour before Mum and Dad picked him up at 10.30 p.m. Meredith could not convince him to stay. I hope this is a start to a better relationship.

83:

84: This was exhausting and my foot was really sore. I took responsibility for medications and dietary needs - big job (on Camp) and I made it bigger than it should have been before camp (PostScript - reflection on the previous comment on thinking about it more).

85:

86: Monday 12.5.03

87: 3.30 p.m. - 5 p.m. Staff Meeting.

88:

89: Billie did presentation for public speaking competitions first - he was excited to do it - his artwork was very creative.

90:

91: To do: Get 32 copies of Entry Form for novel.

92: Photocopy Collections for reading groups.

93: Ask Dallas about public speaking competition.

94: Check with library for novel (they needed to reorder).

95:

96: Tuesday 13.5.03

97: Parent/Teacher interviews from 3:30 p.m. to 9 p.m..

98:

99: I am teaching mathematics to reporting outcomes for the next two weeks then assessing formally.

100:

101: I am so tired.

102:

103: Parent/Teacher interviews went quite well. I came unstuck a bit with a Year 3 G & T [student's] father. He was quoting data about G & T I know nothing about and questioning whether his child is benefiting from doing Year 4 English and mathematics. I quite honestly don't know the answer to this, but put on a smile and suggested he speak to Chris. He also commented on the marking of the homework - saying things in his child's Mentals book are marked right when they are wrong. I explained that the children mark each other's work, I read out answers, ask for answers, discuss problems, but it has to be done as quickly as possible. His wife is the teacher, so I was a little surprised by his attitude. I know I can't mark them - there are often 30 to 40 questions each week. His wife seemed more understanding.

104:

105: There were a few mums of children concerned about relationship problems in one peer group - they have reason to be - I assured them I will seek to ensure students feel safe and asked them to bring issues to me as they arise so they can be dealt with quickly.

106:

107: I offered some parents, with children struggling with reading, some literature and suggested a reading support program. Most respond positively.

108:

109: To do: See Maxie - about Public Speaking (on Dallas's advice).

110:

111: Wednesday 14.5.03

112: The students seemed to do well on relating multiplication and division. I used explanation and demonstration using concrete materials. I don't have time to let them 'discover' it as well as complete pages and I know I have to do it for assessment which is a written test.

113:

114: Today Sidney spoke to me about Dominique. I feel devastated and under scrutiny. I hate this, I feel so 'public' as a teacher. I have had no problems with Dominique, I will ring his parents. Sidney also indicated Billie was scared of me.

115:

116: I feel like I do nothing but school work.

117:

118: Paris got award for improvement - behaviour, Billie for creative artwork.

119:

120: Thursday 15.5.03

121: More Parent/Teacher interviews from 3:30 p.m. to 6 p.m.. They were fine.

122:

123: To do: Merit awards.

124: Borrow metre rulers from other classrooms.

125: Find missing Spelling and Draft books.

126: Find video for sport tomorrow if it rains.

127: Make homework sheet.

128:

129: Saturday 17.5.03

130: This week was awful. Complaints regarding Dominique and continued unhappiness with Billie are really distressing and I feel concerned for them and very vulnerable.

131:

132: P/T interviews went well on person-to-person but feedback from Sidney about Dominique was very upsetting. I am disturbed that parents are not encouraged to approach the teacher and clarify and deal with a problem first. I feel undermined.

133:

134: I rang Dominique's mum and this went well and was no where near the issue I anticipated. Dominique is sensitive [Mother's assessment] (and is unsure of me) and I feel the set up of teaching so many children makes it very hard to know how children are reacting when you don't get to know them [I only have him one hour, four days a week] (Postscript: I spoke to Dominique and reassured him, asked him to come to me if he has any problems or fears. He seemed fine).

135:

136: I feel very constrained by the English/Mathematics groups - time wise and hence teaching and programming. I can never take an extra 10 minutes here or there to catch up/complete something or continue the important discussion etc.

137:

138: I am exhausted. I am working at least 10 hours on the weekend as well as late nights 4 or 5 nights a week. I feel like I am being consumed and never get a break.

139:

140: I have been focusing this week on setting up assessment for reports due in Week 6. Program is due in Week 5.

141:

142: A lot of rain and therefore lunchtimes and recesses have been almost all indoors.

143:

144: I am changing reading groups this week. I spent about two hours on Sunday working this out based on data from Reading Age – Chronological Age – Spelling Age - description scores.

145:

146: Sunday 18.5.03

147: Other school board meeting.

148: To do: Finish homework sheet.

149:

150: Monday 19.5.03

151: 3.30 p.m. - 5 p.m. Stage Meeting.

152:

153: To do: Photocopy: Homework sheets.

154: Mathematics test.

155: Maps of Australia and aboriginal map.

156: S & T p. 4.

157: Letters.

158: RFI sheets.

159: Divinity sheets.

160: Make S & T test.

161: Make HSIE test.

162: Make Divinity test.

163: Mark S & T for reporting.

164: Get overhead pens.

165: Talk to Dannie about HSIE outcome, which rivers, cities etc.?

166: Talk to Maxie about Public Speaking competition.

167:

168: Tuesday 20.5.03

169: 3:30 p.m. Parent/Teacher interview regarding Jude. Mother was concerned about his slowness in completing work, he is a perfectionist, we talked about possible occupational therapy assessment and how we both might assist him.

170:

171: To do: Containers for mathematics.

172: Get 3D shapes.

173: Talk to Alex regarding Parent/Teacher interview [regarding Jude] and follow-up.

174:

175: Wednesday 21.5.03

176: To do: Mass equipment from the store room.

177: Get overhead projector coloured pens.

178: Photocopy: stained-glass window prints on overhead film.

179:

180: Thursday 22.5.03

181: To do: Merit awards.

182: Photocopy: Divinity activity sheets.

183:

184: Friday 23.5.03

185: 3:25 p.m. Parent/Teacher interview:

186: Brooklyn's mother couldn't make it to the parent/teacher interview appointments last week. We talked about his learning difficulties. He needed reassurance that he's getting STLD support and I am focusing on giving him directions clearly and following up with him. She was as happy as could be expected, considering his problems. He seems happy and is well liked by his peers.

187:

188: Saturday 24.5.03

189: Term 2 is a great frustration. I have had to teach to assessment regardless of needs and some areas in mathematics have just been touched on. I feel overwhelmed by this [reporting]. A page for each major subject - 13 outcomes for English and 20 outcomes for Mathematics. Half a page for other KLAs 3-4 outcomes each. A comment on each subject as well as 15 social skills/character outcomes and a comment.

190:

191: I need to plan in Term 3 on reporting outcomes early to feel more in control.

192:

193: I have had a really difficult year too with problems with Billie and Dominique. I have felt criticised by my supervisor and unsupported by her. Thankfully not by Dallas though, I have felt very vulnerable.

194:

195: I have had a really happy week with the children. Paris has been so much better this term and I think my change of approach has helped this a lot. Table points have been much better - no lunch detentions - happier all around.

196:

197: Social problem in one group of children has been a big problem and a lot of parental feedback about children's pain in relation to this group, Dallas has said she will deal with this and I am glad because another mum came to see me today. Billie seems much happier and I am concerned that his desire to change classes and trying to say his unhappiness is due to boredom was to leave the group and save face.

198:

199: I have felt 'on the edge' this week. I am working to 10.30-11 p.m. or later every day and it is getting to me. I have so much on my mind that I don't feel I work very well or achieve as much as I would like.

200:

201: My PhD gets next to nothing in extra time.

202:

203: To do: Merit awards.

204: Photocopy HSIE Local Government activity sheets.

205: Make homework sheet.

206: Tuesday 27.5.03 - Physio

207: Friday 30.5.03

208: To do: Get newspapers for craft activity.

209:

210: Saturday 31.5.03

211: This has been another tough week. I feel overwhelmed with the feeling of being vulnerable to so many people.

212:

213: I had a big think about the issue of G & T [arising from P/T interview] and realised what the problem was [me] being under-prepared. Teaching accelerated children I thought I should treat and assess them [the same] as the others [without a thought of how they were performing comparatively in the cohort]. [Coby's] father's comment about stat[istic]s put me on the 'back foot' and I then thought [if it is true] that unless they are performing in the top 20% of the cohort they should not be accelerated [I need to be assessing them with this in mind]. Feedback from Chris says something else, though Dallas related that Gabriel says 10%. I have been encouraged that we are having some info given by Chris soon.

214:

215: I have been doing school work for reporting every night until at least 10.30 p.m. and - Saturday night until 12.30 a.m.. I feel exhausted and rung out. This week will be spent keeping children occupied profitably while filling in the gaps in assessing. We were told this week that the reports due date has been moved from Friday 6.6 to Tuesday 10.6 I can't cope with the thought of doing this for another weekend I must have it done by Friday. My weekend has been reporting and sleeping -

what a life. I also have to have a uni meeting this week - it is planned for next Sunday - but will this be possible?

Monday 2.6.03

3.30 p.m. - 5 p.m. Stage Meeting.

To do: Photocopy: Applications for novel.
Homework sheets.
Get containers and equipment for volume activities.
Bring tins from home for Mass activities.
Make an activity sheet for Mass.
Set up computer for spell check test.
Get S & T books.
Get interview reports for homework books.
Make test for local government.
Organise extracurricular activities.

Tuesday 3.6.03

To do: Photocopy: History of communication sheets.
Bring in savoury for morning tea.
Organise coloured papers for origami houses.

Thursday 5.6.03

To do: Merit awards.

Friday 6.6.03

Off sick.

To do: Hand in reports? Moved to Tuesday.

Monday 9.6.03

Holiday.

Tuesday (morning) 10.6.03

247: I was sick - stress on Friday. I slept until 1 p.m. and started work on reports at about 2 p.m. Saturday 10.30 a.m.-11.30 p.m. to finish them. I have worked every night last week as well until at least 10.30 p.m. I have been feeling ‘punchy’. Handwritten reports are crazy and add about one and a half day (12-15 hours) of extra work and I think it is disgraceful. Why is this not available on disk?

248:

249: Monday was a school holiday - thankfully. I am very distressed and I got knots in my stomach at the thought of going back to school today. I don’t know how I am going to make it to holidays. I still have to plan for this week and mark reports on communication as well as two lots of homework. I don’t feel capable of more than the planning. We are not doing homework this week (agreed with Dannie).

250:

251: I am so overwhelmed by the survival, I cannot concentrate on improving mathematics teaching. I feel the only worthwhile thing I have done there is helped them learn their 8 and 7 times tables through drill speed tests against themselves.

252:

253: Wednesday 11.6.03

254: To do: Photocopy: Materials for divinity.

255: Get 3D shapes.

256: Bring pantry objects for mathematics.

257: Get chapel book to prepare for chapel.

258: Check computer bookings.

259:

260: Thursday 12.6.03

261: To do: Merit awards.

262: Get dice.

263: Get materials to make S & T projects.

264: Get S & T magazines.

265: Get craft materials.

266:

267: Saturday 14.6.03

268: I’m feeling more relaxed having completed reports - it took me all week to unwind and I no longer feel so fragile.

269:

270: Monday 16.6.03

271: 3.30 p.m. - 5 p.m. Stage Meeting.

272:

273: To do: Get cardboard/dice etc. for game.

274:

275: Tuesday 17.6.03

276: To do: Get a new book for shared reading.

277:

278: Wednesday 18.6.03

279: To do: Chapel preparation.

280: Assembly preparation.

281:

282: Thursday 19.6.03

283: To do: Merit awards.

284: Chapel preparation.

285: Make homework sheet.

286:

287: Friday 20.6.03

288: To do: Chapel preparation.

289: 3:25 p.m. parent/teacher interview. Phoenix’s mother could not come to previous parent/teacher interviews. Phoenix has learning difficulties, Mum just wanted to touch base.

290:

291: Saturday 21.6.03

292: Only one more week to go and frankly that’s all I can focus on - surviving another week and coping with chapel this week. I am nervous about chapel.

293:

294: Monday 23.6.03

295: 3.30 p.m. - 5 p.m. Staff Meeting.

296:

297: To do: Chapel preparation.

298: Get video for English.

299: Photocopy: Spelling sheets.

300: Homework sheets.

301: Get overheads.

302: The projector.

303: Write up the words for song for chapel.

304:

305: Tuesday 24.6.03

306: To do: Chapel preparation.

307: PE trials.

308:

309: Wednesday 25.6.03

310: To do: Chapel preparation.

311: Look up Anders Celsius on the Internet for mathematics tomorrow.

312:

313: I have spent 3 nights doing a presentation for Chapel - enjoyable - but stopped me doing any work for next term.

314:

315: Thursday 26.6.03

316: To do: Merit awards.

317: Get temperature materials from a store room.

318:

319: I am not happy with how I did subtraction with trading. A lot of children had trouble with trading - some children trade if they need to or not.

320: E.g. 27 - 5 = ?

321: $^{1}\cancel{2}^{17}\cancel{7}$

322: $\underline{-\quad 5}$

323: 112

324: I gave children an opportunity to work out an algorithm at first but ended demonstrating and giving lots of practice. Lots of children do the subtraction in their heads and can't work out how to use trading marks. I don't know how I'd do it differently. Children had MAB blocks which they used with place value charts leading to using MAB blocks to complete their textbook questions (pp. 73, 74, 76, 77).

325:

326: I decided to call table groups to the floor while others worked on and they showed me individually what they were doing and I worked with them if they were having problems but this took all week to do (some children loved it, some children had had enough).

327:

328: Friday 27.6.03

329: To do: Meet Glenn in G8, 9, 10 to set up for chapel at 8 a.m.

330: Chapel was great and the rest of the day was cleaning up and finishing off units.

331: Children enjoyed displaying their communication methods for S & T in the playground.

332:

333: Saturday 28.6.03

334: I am so happy that the term has ended although we have a two day conference next Monday and Tuesday. I am completely exhausted and in some ways demoralised. I am so tired of school work which seems to take up every waking moment, and I am not exaggerating when I say I feel physical revulsion at the thought of doing any school work or preparation. I am concerned about coming back to school unprepared for next term but can’t do anything about it - I am so tired.

335:

336: Monday 30.6

337: Conference on coping with stress and G & T.

338:

339: Tuesday 1.7.03

340: Conference on coping with stress and G & T.

341: This was amusing as the stress management course talked about the need to take as much time as it took to accumulate the stress to recover - just how are we to do this? Many laughed at the fact that we were at a conference rather than on leave.

Year 4 Mathematics Diary, Term 3, 2003

Note: All names except those of my family are pseudonyms.

1: Saturday 5.7.03

2: Son's engagement party.

3:

4:

5: Holidays - went away for ten days and vegged, this was so necessary - I did no school work so will be going back to school with next to nothing done except making program notes today before school starts tomorrow, so I have an idea of where I am.

6:

7: Monday 21.7.03

8: School started again.

9:

10: To do: Mark for public speaking.

11: Mark projects.

12: Get contracts for school magazine.

13:

14: Wednesday 23.7.03

15: We had a mathematics comp today.

16: Found out tonight Simone is pregnant!!!

17:

18: To do: Get grid paper.

19:

20: Thursday 24.7.03

21: To do: Merit certificates.

22: Get "*My Place*" (Wheatley, 1987) for HSIE.

23:

24: Students used shorts to make rectangles and work out factors - children can do the activity but don't necessarily make the connection with factors - it's interesting how many activities are like this – e.g. using MAB blocks to trade successfully but not making the connection with trading marks even though they do the activity over and over again as they complete problems.

25:

26: Monday 28.7.03

27: 3.30 p.m. - 5 p.m. Staff Meeting.

28:

29: To do: Get novel and resources.

30: Get the bulk loan for silent reading.

31:

32: Tuesday 29.7.03

33: Half day sports carnival.

34:

35: Wednesday 30.7.03

36: Sports carnival.

37:

38: Thursday 31.7.03

39: To do: Merit certificates.

40: Photocopy: Novel activity sheets.

41: Get the bulk loan for silent reading.

42: Focus on ‘tricky bits’ next week.

43: Make homework sheet.

44:

45: Friday 1.8.03

46: School closed due to contamination of building site - I should have done programming but spent the day in bed with a headache.

47:

48: Saturday 2.8.03

49: Church trivia night.

50:

51: Sunday 3.8.03

52: Barbecue at Jan's place.

53:

54: To do: Finish homework sheet.

55:

56: Monday 4.8.03

57: 3.30 p.m. - 5 p.m. Staff Meeting.

58:

59: To do: Photocopy: homework sheet.

60: Get the bulk loan for silent reading.

61:

62: 3:30 p.m. to 8:50 p.m. Parent/teacher interviews.

63:

64: Tuesday 5.8.03

65: To do: Photocopy: Sheets for English.

66: Check about parent/teacher interviews.

67: Get pipe cleaners and something to join them.

68: Get straws.

69:

70: Wednesday 6.8.03

71: To do: Buy fasteners.

72: Photocopy: Skeleton sheets.

73: Sheets for newspaper article.

74:

75: Thursday 7.8.03

76: To do: Merit awards.

77:

78: 3 p.m. to 6 p.m. Parent/teacher interviews.

79:

80: Friday 8.8.03

81: Japanese exchange students in class today.

82:

83: Saturday 9.8.03

84: I have found it so hard to get into programming this term. I still feel drained and get feelings of revulsion at school work - which seems to take so much time.

85:

86: I finally stopped fiddling and got stuck into it and achieved a bit, but I'm so tired of it. At the moment deadlines seem to be my only motivation plus survival. I plan what I need while trying to keep on top of marking and programming HSIE (for the others on my Stage).

87:

88: Monday 11.8.03

89: 3.30 p.m. - 5 p.m. Stage Meeting.

90:

91: To do: Get Unifíx cubes.

92:

93: Tuesday 12.8.03

94: 9 a.m. to 10.30 a.m. Life education program today.

95:

96: Wednesday 13.8.03

97: 12:05 p.m.: Author's visit.

98:

99: Thursday 14.8.03

100: To do: Merit certificates.

101: Get tangrams.

102: Photocopy: Divinity craft sheets.

103: Make homework sheet.

104:

105: Friday 15.8.03

106: Japanese students joining in sport today.

107:

108: Saturday 16.8.03

109: I still have work to do on my program and feel really pushed to get it done, but have no energy or enthusiasm. I seem to fiddle.

110:

111: I have done HSIE for the Stage while S & T, Divinity and PDHPE are being done by different teachers on the Stage for us all.

112:

113: I have only been responsible for English, Mathematics, Creative and Practical Arts and Computing, yet it seems so hard. The HSIE unit is difficult - resources for local aboriginal societies require research to places I haven't got time for and we really should have an aboriginal cultural experience with a speaker or an excursion. I will recommend it for next year.

114:

115: I have used the textbook and last year's program to program for mathematics and finally got a copy of the Teacher's Resource Book for the text which has some helpful things in it. I have found it too hard to incorporate open-ended questions and problem solving approaches with the [school] emphasis on textbook coverage. I feel overwhelmed by the amount of work required, not only in programming, so the text is a life saver. I feel I am coming to terms with the content of the Year 4 mathematics course (this is true of all subjects - HSIE, S & T especially) - grammar too!

116:

117: Sunday 19.8.03

118: To do: Finish homework sheet.

119:

120: Monday 18.8.03

121: 3.30 p.m. 5 p.m. Staff Meeting.

122:

123: To do: Finish testing in English.

124: Commence Diagnostic reading testing.

125: Photocopy: Homework sheet.

126: Pulse activity sheets.

127: Bracelet page.

128: Work problem sheets.

129: Find out about muscles (voluntary, involuntary).

130:

131: Tuesday 19.8.03

132: To do: Get maps.

133: Look up Life Education site/human body site.

134:

135: Wednesday 20.8.03

136: To do: Make a scroll (letter) for Divinity lesson.

137:

138: Give apologies for meeting (of a board I am on) I cannot attend today - programming.

139:

140: Thursday 21.8.03

141: To do: Merit certificates.

142:

143: Leading assembly today.

144:

145: To do: Finish English testing.

146: Continue diagnostic testing.

147: Hand in my program.

148:

149: Saturday 23.8.03

150: I thought things were going well with Billie - he's not warm but laughs at my jokes and usually takes part in activities. I saw some problems with paired reading (he moaned when told we would be doing it for a while) and treating Alex (STLD teacher) the same way [he treats me]. I was a little disturbed that he sits up straight and shoots his hand up for Chris (G & T teacher) and this is awful. But this afternoon his behaviour was awful to Martie when seats were changed and I got a call from mum to complain because Billie was hysterical. I explained the circumstances and was told (by his mother) that children this age behave like this and that Martie stinks and gets into trouble (neither are true). His mother wants Billie moved to Year 5 for a trial and I will speak to Dallas and pass this on. I spoke to Sidney and she was supportive. I cried.

151:

152: My program got a good response from Sidney. Thankfully it is over now for another five weeks.

153:

154: Monday 25.8.03

155: Mid term break.

156:

157: Tuesday 26.8.03

158: To do: Photocopy: Diary sheets for "*Sadako*" novel (Coerr, 2002)

159: "Forgive" template on cards - 32.

160: Make double page for 4F for end of year magazine.

161: Get grid paper.

162:

163: Thursday 28.8.03

164: To do: Merit certificates.

165: Get S & T video.

166: Photocopy: Grid paper onto overhead.

167: Organise merit cards for sport.

168: Organise T-ball equipment.

169: Prepare for casual tomorrow.

170: Make homework sheet.

171:

172: Friday 29.8.03

173: I did not teach - Elise had an Immunologist's appointment.

174:

175: Sunday 31.8.03

176: Billie was not at school all week - pneumonia - but I have been very upset since Wednesday when Dallas told me she was going to give him a trial in Year 5 (Postscript: This in fact did not occur, following Dallas's consultation with Chris - placing him in the other Year 4 class was also considered but not done - Dannie was not happy to have him, I don't know if that was the deciding factor. The decision to leave him in my class was never explained).

177:

178: Billie has shown no giftedness in mathematics as evidenced in Week 1 of Term 1 in the mathematics pre-test which determined Chris's selection of G & T students for acceleration. His results all year have borne this out. He tries to cover up his inability to understand and will never ask for help (covers up answers when I walk by). I think he feels threatened by my knowing he has struggles (and is not gifted in this area).

179:

180: Elise's Immunologist's appointment was upsetting with her crying and having three other specialist appointments to go to. She cried tonight about being normal and having difficulty concentrating for exams this week. She has worked so hard to complete assessment tasks this week and is very tired. I am starting this week in a bad place.

181:

182: Sunday 31.8.03

183: I had to produce a double page for the coloured school magazine that comes out. I didn't know what to do. Finally decided to show pictures of all the students and their art/craft displayed around the room and a find-a-word with all their names in it. Heading "4F is very creative". The find-a-word program in the library is great but it took me a fair while to get it done (couple of hours). I then took photos of the class and artwork. I hope it turns out OK.

184:

185: Monday 1.9.03

186: 3.30 p.m. - 5 p.m. Staff Meeting.

187:

188: To do: Look at play for Divinity.

189: Make transparencies for mathematics.

190: Gets cardboard etc. for posters.

191: Speak to Gabriel about Elise.

192: Make specialist appointment.

193:

194: Tuesday 2.9.03

195: To do: Get card template.

196: Photocopy: Homework sheets.

197: Division sheets.

198: Numeral expanders (Teacher Resource Book).

199: Overhead transparencies (100 square p.188).

200: Digestive system sheets.

201: Nervous system sheets.

202: Money paper.

203: PDHPE booklets.

204: Pop-out for Father's Day Card.

205: Template for Father's Day Card.

206:

207: A ray of sunshine in an otherwise tough few days - starting school today was a real effort - my concerns for Elise are exacerbated by feeling a failure with Billie - I had a mother of a child at the school, but not in my class (I don't know her name, but I see her often when she helps out at the uniform shop which is just outside the glass door leading from my classroom to the library), tell me that she watches me and what a terrific job I am doing. I thanked her and told her I needed to hear that today.

208:

209: Wednesday 3.9.03

210: To do: Accept public speaking invitation.

211: Write invitations for children's presentations.

212: Photocopy: Divinity sheets.

213: Invitations.

214:

215: Thursday 4.9.03

216: To do: Merit awards.

217: Send home invitations.

218:

219: Friday 5.9.03

220: To do: Get butcher's paper.

221: Assess reporter role in PDHPE groups.

222: Send home invitations.

223:

224: Saturday 6.9.03

225: This week started awfully. I was in a really bad place emotionally with concerns about Elise and her sadness and stress. The situation with Billie was just awful - he had a dummy spit Monday - and the seeming lack of support form Dallas in particular was very distressing. Chris was helpful. Thankfully good news on Elise's blood tests has helped a lot - I felt like a load had been lifted from me and I feel a lot more resilient on the Billie front. I have decided to stop allowing the passive aggressive stuff. He will have the same expectations as others. He is not going to come to 'like' me but he will be respectful or get the same response as anyone else if they act that way.

226:

227: Monday 8.9.03

228: 3.30 p.m. - 5 p.m. Staff Meeting.

229:

230: To do: Look at money pages.

231: Get floppy disks.

232: Book laptop and projector for 12:05 p.m. Friday.

233: Make an extension activity book.

234: Make an aboriginal booklet.

235: Get plastic money.

236: Photocopy HSIE debate sheets.

237: p.9 of Sadako (Coerr, 2002) worksheets.

238: p.11 of Sadako (Coerr, 2002) worksheets.

239:

240: Tuesday 9.9.03

241: 4 p.m.. Inservice.

242:

243: Thursday 11.9.02

244: To do: Merit awards.

245: Organise money lesson.

246: Make homework sheet.

247:

248: The money unit went well - children thoroughly enjoyed buying and selling. The shop with real stuff was great, though quite a sugar burst for both mathematics classes.

249:

250: Church function.

251:

252: Friday 12.9.03

253: To do: Book projector and laptop.

254:

255: 5 p.m. Physio.

256:

257: Monday 15.9.03

258: 3.30 p.m. - 5 p.m. Stage Meeting.

259:

260: To do: Find an origami crane.

261: Get a ‘find-a-word’.

262: Pay for Wednesday (Public Speaking dinner).

263: Photocopy: p. 31 for HSIE.

264: Homework sheet.

265: Divinity activity on two sheets.

266:

267: Tuesday 16.9.03

268: Prefects Awards assembly.

269:

270: To do: Get children's projects off library computers for Friday's presentations.

271:

272: Wednesday 17.9.03

273: To do: Organise activities for Grandparents’ Day.

274:

275: 6 p.m. to 10 p.m. Public Speaking competition finals.

276: The public speaking final was great for my children (two children in my class made it into the final and they came second and third). The parents were chuffed.

277:

278: Thursday 18.9.03

279: Grandparents’ Day. Special activities from 9 a.m. to 12 p.m. Very busy, chaotic and great fun!

280:

281: Friday 19.9.03

282: Parents have been invited to watch their children's PowerPoint presentations today.

283:

284: To do: Setup computer and run through presentations.

285: Setup projector and laptop at lunchtime.

286:

287: The PowerPoint presentations to parents were great. The children were very proud of their efforts and parents were obviously very proud of their children. Lots of positive feedback (about 20 parents attended).

288:

289: Saturday 20.9.03

290: Women's convention all day.

291:

292: The marking of textbooks is burdensome. The children get so bored yet the opportunity to share their answers and how they got them should be valuable. I feel I have failed in implementing active learning strategies, how to do it while introducing and reinforcing trading and trading marks for both + and - is difficult. I don't know how to do it.

293:

294: It's OK for Space and Measurement, it's Number that is difficult while covering content, especially algorithms and preparing the children for higher mathematics.

295:

296: I felt I was helpful in highlighting the problem lots of children are having with subtraction.

297: E.g. 44

298: <u> -7</u>

299: <u>43</u>

300: I reminded the children that "maths makes sense" and encouraged them to estimate the answer first and check if their answer makes sense i.e. 44 take away 7 can't possibly be just 1 less.

301:

302: I might pursue this next term as a priority.

303:

304: I can't think of any other way.

305:

306: How do you overcome the ‘playing with numbers’ rather than the numbers and symbols representing what you do with them?

307:

308: Monday 22.9.03

309: 3.30 p.m. - 5 p.m. Stage Meeting.

310:

311: To do: Photocopy: PDH activity sheets.

312: Get volume materials from mathematics storeroom.

313:

314: Tuesday 23.9.03

315: To do: Bring eye droppers from home.

316: Photocopy: HSIE sheets.

317:

318: Wednesday 24.9.03

319: To do: Pick up recording equipment from uni.

320:

321: Thursday 25.9.03

322: To do: Merit certificates.

323: Photocopy: S & T revision sheets.

324: Take back recording equipment to uni.

325:

326: I videotaped this lesson today - it was OK but just not enough equipment so groups’ experiences of the eye droppers (2 for the whole class) was to take turns. The results were all over the place (teaspoon between 2 and 15 ml, eggcup 2-43 ml). Not enough time for a full discussion - though discussion is difficult - rules for discussion need to be firmly enforced. Children break off into personal conversations all the time - it is tough to break this up and stay together as a group and actively listen to each other.

327:

328: Friday 26.9.03

329: To do: Clean up the classroom,

330: Get children to clean out tote trays etc.

331: Clean desks.

332: Take books back to library.

333:

334: Saturday 27.9.03

335:

336: Term has finished - hooray!

337:

338: I feel relieved - I stayed up to 11 p.m. last night marking and still have a lot of marking to do. I will try to have a week off next week.

339:

340: I feel daunted about next term - we have programming again and reporting - I actually feel scared about the affect of this on me after Term 2. I can’t wait till the end of the year.

341:

342: I am responsible for Divinity program next term.

343:

344: Monday 29.9.03

345: Doctor’s appointment.

346: I saw one of my university supervisors today and talked a bit about my PhD and how teaching is so time consuming and he reassured me that you learn to streamline with experience - it seems heartless, though, that new teachers have to work under so much pressure, without more time for preparation and marking.

347:

348: Tuesday 30.9.03

349: 12:15 p.m. Elise's heart specialist appointment.

350:

351: Wednesday 1.10.03

352: Chiropractic appointment for headaches.

353: 11 a.m. Appointment.

354: 3 p.m. Appointment.

355:

356: Thursday 2.10.03

357: Appointment.

358:

359: Friday 3.10.03

360:

361:

362: Saturday 4.10.03

363: Friends for dinner - 6 p.m..

364:

365: Tuesday 7.10.03

366:

367:

368: Saturday 11.10.03

369: Appointment.

Year 4 Mathematics Diary, Term 4, 2003

Note: All names except those of my family are pseudonyms.

1: Monday 13.10.03

2: Staff day including first aid certificate.

3: 5 p.m. physio.

4:

5: Tuesday 14.10.03

6: Staff day including first aid certificate.

7: 5:45 p.m. Doctor’s appointment.

8:

9: Wednesday 15.10.03

10: Students started today.

11:

12: To do: Photocopy: Problem solving sheets.

13:

14: Thursday 16.10.03

15: Uni meeting.

16: Wal gone to Brisbane for four days.

17:

18: Friday 17.10.03

19: Uni meeting.

20:

21: Saturday 18.10.03

22: Appointment.

23:

24: To do: Work out if I have finished evaluating mathematics and writing.

25: Find out when I am on Chapel.

26: Work out what I need to do to program divinity.

27:

28: Sunday 19.10.03

29: 5 p.m. pick up Wal from the airport.

30:

31: To do: Buy toys and lollies for school.

32:

33: Monday 20.10.03

34: 3.30 p.m. - 5 p.m. Stage Meeting.

35:

36: To do: Get thermometers.

37: Get big balls.

38:

39: Mathematics results in for the competition. Paris topped the grade - he was shocked - everyone was - he will need to be assessed by Chris. Our results were below the state average - though all our children are entered into the comp.

40:

41: Tuesday 21.10.03

42: Meeting.

43:

44: Wednesday 22.10.03

45: To do: Buy toys [for school].

46: Write-up awards for assembly tomorrow.

47: Organise homework sheet for HSIE.

48:

49: I felt I did poorly today in mathematics - I was not well enough prepared and was not sure of the intent of the lesson (rigid shapes and paper folding). I could have made it more challenging by providing open-ended challenges rather than copying text - but not prepared enough - just not the time with programming. Ellis said “Maths is boring” - I need to improve.

50:

51: I’m not feeling great - I think I’m getting something (achy, tired, sore throat). I’m going to prepare for a casual tomorrow in case I don’t feel well enough to come in, then I don’t have to drag myself in or send something by email in the morning.

52:

53: Thursday 23.10.03

54: Off sick.

55:

56: To do: Make homework sheet.

57:

58: Friday 24.10.03

59: To do: Get bulk loan of books for silent reading.

60:

61: 6:15 p.m. Elise's doctors appointment.

62:

63: I will try to make a more detailed day plan so that when I am sick I don’t have to drag myself to school or provide detail from home for the casual. I feel the requirement to leave a day’s work is unreasonable, if the program is there that should be enough if you are sick. But I think a more detailed day plan will help improve the quality of my preparation and, therefore, my lessons.

64:

65: Saturday 25.10.03

66: Priyani's birthday.

67:

68: I feel like I have moved a step further in terms of preparation. My daybook will be used for two things, not only to give a summary for me and a daily schedule but it will be more detailed and available for casuals if I am sick. This is making me feel more in control, because I get more of a handle on the content (in all KLAs). I found this a problem in mathematics this week with Ellis’s comment giving me a reality check. The next couple of weeks in mathematics includes a lot of revision leading to Week 5 exams. This may be dull - I can’t see how that can be helped except by getting children to write problems and putting them on the board (overheads!!) YES!! YES!! YES!!. At least then there will be ownership.

69:

70: Monday 27.10.03

71: 3.30 p.m. - 5 p.m. Staff Meeting.

72:

73: To do: Photocopy: Divinity crossword for each child.

74: Divinity crossword onto overhead.

75: James 3: 1-11.

76: Divinity summary sheets.

77: Homework sheet.

78: Get blank overheads for mathematics (10).

79: Get student's award signed by Gabriel.

80: Finish mathematics program and evaluations.

81:

82: Tuesday 28.10.03

83: To do: Divinity, S & T, HSIE follow-ups if time.

84:

85: Wednesday 29.10.03

86: To do: Write up teacher's awards.

87:

88: Program handed in. I went home sick before lunch with a migraine. Dallas took my class and did Divinity lesson, which I left for her. I slept all afternoon.

89:

90: Thursday 30.10.03

91: To do: Merit awards.

92:

93: I went to work but my head was not clear - it was a struggle but I survived.

94:

95: 3:15 p.m.. Parent/Teacher interview. One of the children is having issues with another child in the class. Mum and I talked about a way forward. I will speak to the other child, get his side and deal with any issues, making sure 'bullying' is not happening.

96:

97: Friday 31.10.03

98: To do: Organise [string]line craft, see Dannie.

99: Collect materials for S & T sound project.

100: Work out points for different school awards.

101:

102: Saturday 1.11.03

103: It was a disrupted week because of my illness. I really feel the need to revise for exams but keep losing time. Mathematics is always catch-up with slow workers and marking. Marking is shocking. We do it as a group but it takes so much time. I think this is the major problem with textbooks rather than problems solving - but I can't change that here.

104:

105: Monday 3.11.03

106: 3.30 p.m. - 5 p.m. Staff Meeting.

107:

108: To do: Photocopy: Early finishers' English sheets.

109:

110: Tuesday 4.11.03

111: To do: Get a sheet for subject and predicate.

112: Photocopy: String designs.

113: Divinity sheets.

114: Check milk sites on the Internet.

115: Chapel preparation.

116:

117: Wednesday 5.11.03

118: To do: Chapel preparation.

119:

120: Thursday 6.11.03

121: To do: Merit awards.

122: Chapel preparation.

123: Remind class to bring in sound materials tomorrow.

124: Remind class about Chapel requirements.

125: Make homework sheet.

126:

127: Doctors appointment.

128:

129: Friday 7.11.03

130: We did Chapel today.

131:

132: Saturday 8.11.03

133: A frantic week - chapel preparation took up so much time - I feel I am so far behind on everything else. To revise mathematics this week I provided work on an overhead which we completed question by question. I then photocopied Dannie's [revision sheet] onto overhead and we completed and marked them together as we went - very teacher directed - but time restraints are huge. So much for getting children to write their own problems - just not time to fiddle while getting what we need [suitable questions] to cover the work. Next week is testing and assessment tasks. I don't feel everything has been covered adequately. Thinking how I can revise again.

134:

135: Sunday 9.11.03

136: To do: Finish homework sheet.

137:

138: Monday 10.11.03

139: 3.30 p.m. - 5 p.m. Staff Meeting.

140:

141: To do: Remind children to make a [sound] device for tomorrow.

142: Photocopy: Subject and predicate sheets.

143: Homework sheets.

144:

145: 5:20 p.m. physio.

146:

147: Tuesday 11.11.03

148: Wal took Elise to specialist appointment.

149:

150: Wednesday 12.11.03

151: To do: Remind children about expected behaviour for inclusion to the theatre tomorrow.

152:

153: Thursday 13.11.03

154: To do: Merit awards.

155: Remind children no lunch orders tomorrow, swimming.

156: Assess S & T devices.

157:

158: Went on an excursion to see a movie based on a book we are reading with the other Year 4 class - we had a great time - though some of the children were scared. We had a terrific time in class reading the novel - children were on the edge of their seats.

159:

160: Friday 14.11.03

161: Sick. 2 p.m. doctor's appointment.

162:

163: Saturday 15th November, 2003

164: Testing is basically finished - I wished I had taken Dannie's advice about the mathematics exam being too long (number in particular was very long), marking it was a nightmare. I am overwhelmed with the amount of work involved in just ticking boxes, honestly. (We still have hands on assessment tasks to complete which is difficult while keeping the rest of the class occupied. You just have these children who eat up the work and others who don't finish much at all).

165:

166: Monday 17.11.03

167: 3.30 p.m. - 5 p.m. Staff Meeting.

168:

169: To do: Get metre pipes from a storeroom.

170: Get diagrams of 3D objects.

171: Get centicubes.

172: Get mass equipment.

173: Complete catch-up exams.

174:

175: Tuesday 18.11.03

176: To do: Photocopy: subject and predicate sheets.

177: Give HSIE exams to two students who missed out.

178: Check other outcomes.

179:

180: Wednesday 19.11.03

181: To do: Collect "Toys and Tucker".

182: Give HSIE exams to two [other] students who missed out.

183: Continue mathematics assessments.

184:

185: Thursday 20.11.03

186: To do: Merit certificates.

187: Continue mathematics assessment tasks.

188: Remind students no lunch orders tomorrow, swimming.

189: Make homework sheet.

190:

191: Saturday 22.11.03

192: I have spent 20 hours marking mathematics exams for 62 children (Dannie did English). Wal helped me and his hours are included in the total.

193:

194: I have spent such a long time preparing to write reports and the thought of handwriting them is almost nauseating - I wrote or typed all day Sunday and half Saturday and both nights. Stuff up with the template for mathematics made me behind. I rang Dallas and she advised me not to do them till Monday when they made a decision whether to print them again or not (they decided not to, so I could have done them anyway).

195:

196:

197: Still have more to do on the reports this week.

198:

199: Sunday 23.10.03

200: To do: Finish homework sheet.

201:

202: Monday 24.11.03

203: To do: Photocopy: Homework sheets.

204: Get magnetic MAB materials.

205: Get overheads.

206: Diagnostic Spelling testing with Alex.

207: Get equipment for posters for PDH.

208:

209: Tuesday 25.11.03

210: To do: Organise children to bring in shoe boxes.

211: 6:15 p.m. Doctor’s appointment.

212:

213: Thursday 27.11.03

214: To do: Merit awards (for assembly).

215: Photocopy: Grammar sheets.

216: Mass sheets.

217: Do Teacher's Awards (for Speech night).

218:

219: Still doing report rewrites.

220:

221: Saturday 29.11.03

222: I handed in my reports in Wednesday to Sidney (on time) but had a lot of re-writes. I have to say, handwritten reporting takes at least 12 hours more time [than reporting on computer] and corrections are so frustrating, I corrected one sheet four times and became almost paranoid of making a mistake when completing them.

223:

224: I am absolutely exhausted and feel ‘flat’, almost don’t know what to do with myself.

225:

226: My mathematics has been very traditional but I haven’t worked out another way to teach the algorithms adequately - I have focused on content.

227:

228: I have used overheads all week to mark and demonstrate results - went well. Most children have got it (I think - short term at least).

229:

230: A lot of children had trouble with decimal notation - particularly .05 = 5 hundredths and .5 = 50 hundredths or 5 tenths, some even thought ‘hundreds’. I am not sure MAB blocks help being used for more than one thing at this age e.g. shorts = units or one as well as one hundredth etc.

231:

232: Monday 1.12.03

233: 3.30 p.m. - 5 p.m. Staff Meeting.

234:

235: To do: Photocopy: Children's Find-a-Words.

236: Divinity materials.

237: Revision sheet from Resource book on square metres.

238:

239: Tuesday 2.12.03

240: To do: Mark projects.

241: Remind students about shoe boxes.

242: Bring in shoe boxes from home.

243:

244: Wednesday 3.12.03

245: To do: Mark mathematics textbooks and Grid books.

246: Finish mathematics Scope and Sequence.

247: Pick up recording equipment from uni.

248:

249: Thursday 4.12.03

250: Mathematics lesson videotaped today.

251:

252: To do: Merit certificates.

253: Mark English textbooks.

254: Mark English workbooks.

255: Finish mathematics Scope and Sequence.

256: Take recording equipment back to uni.

257:

258: Saturday 6.12.03

259: I thought I had finished the bulk of it but have had to do mathematics curriculum (for BOS registration) write ups to hand in by yesterday.

260:

261: Monday 8.12.03

262: To do: Clean up the classroom,

263: Get children to clean out tote trays etc.

264: Children take home books.

265: Clean desks.

266: Take books back to library.

267: Remove things from walls.

268: Clean out cupboards.

269:

270: Thursday 11.12.03

271: Last day for students. We have presentation night tonight. The day has been quite emotional. The week has been one of Christmas activities and cleanup. I am emotionally and physically spent.

272:

273: Friday 12.12.03

274: Last day for staff. We had to be at school till 12 p.m. to answer any questions about reports which were handed out last night. Last night was a good night - children were great. Lots of lovely feedback from a lot of parents. I am so glad it is finished. I feel zombie-like. Now I have to start on Christmas for the family.

275:

276: Friday 19.12.03

277: I was literally unable to do anything until Thursday - just pooped! Caught up with a group of primary school teachers yesterday and they are all the same - made me feel better about how I feel - maybe it's not just me.

278:

279: Tuesday 27.1.04

280: Wal had the time off between Christmas and New Year and I honestly cannot remember what we did - I did a lot of reading (light stuff only) I think. I did shopping etc. between 1st and 10th of January when we went away for two weeks. We did next to nothing on holidays, read, watched the views, saw movies - I really needed it - I am starting to recover - I don't know how it would be if I had to teach again full-time - I don't think I am up to it, in the near future anyway.

281:

282: **Action Research focus:**

283: I feel I am a lot more comfortable with the Year 4 content and have gained insights into common ways students approach some of the content, e.g. Some students will still subtract the little number from the big number (in a column) rather than trade, or trade whether they need to or not, to answer a question. In an ideal world I would teach this grade again (maybe twice more) to consolidate my content understanding and give myself the opportunity to focus on developing a more problem solving classroom, incorporating more features of best practice consistently and thoughtfully.

284:

285: At the end of 2002 I ranked myself against the criteria I see as describing best practice in teaching mathematics. I think it would be useful to rank myself (out of 10) at the end of my second year of teaching mathematics.

286:

287: I have developed:

288: • useful behaviour management skills using both positive and negative reinforcement, but focusing on the positive, with Year 4 children (9).

289: • a safe risk taking environment where children feel safe to share their answers and thinking (9).

290: • my understanding of the content of Year 4 mathematics (7).

291: • my understanding of the possible ways Year 4 children will approach different aspects of mathematics and their mathematical thinking (4).

292: • a problem solving approach to enable Year 4 children to 'discover' the mathematics (3).

293: • a culture of 'talking about doing mathematics' in this Year 4 class (4).

294: • a culture of participating cooperatively in a group to solve problems and present your solutions to others (3).

295: • a culture where mathematics is not about getting ‘right’ answers but about the process of getting an answer (6).

296:

297: **Postscript** (February 2006):

298: I have included details in this diary from my own organising diary as well as my teaching daybook and diary reflections. Teaching full-time I felt my family, church, school board, education commitments as well as my own health and my daughter’s health concerns were all factors needing consideration when analysing my teaching experiences. While uncertainty still surrounds my daughter’s health, things have settled considerably and there is hope that her illness was induced by medication rather than occurring naturally. However, the first nine months of 2003 were quite a traumatic period for her and the symptoms she was experiencing were quite frightening for her and our family. This did affect my emotional state, and while I feel it did not affect my teaching or teaching preparation, it no doubt affected my ability to cope with stress.

Video Notes Year 4 – 3.4.03

1: **Note**: All names except those of my family are pseudonyms.

2: **Lesson Notes Year 4 2003 3.4.03 Term 1 Week 10**

3: Some children came into class late. Other students were giving out speed textbooks. I say "ladies and gentlemen you are very late". I organise a seat for the extra student (there are more students in this class than in the normal Year 4 class I teach). Children are taking a long time to get organised and settle. I say "eyes this way 1, 2, 3, Jamie that's very good". I explain what is happening with the videotaping and introduce the person running camera.

4:

5: I look at the o'clock I say "we'll start when it gets to 12, ready set go!" The children start their tests, I get a textbook and look through it while the students do their speed test. I tell them one minute has passed. One minute 30 seconds. One minute 45 seconds. Two minutes… until three minutes has passed when I say "pencils down". Students talk and get ready to mark, they swap their books. I say "Are you ready, all right…". In a quiet voice I read out the answers (three times tables and extensions e.g. 3 x 60, some questions used the term 'score' and 'dozen' etc.). When the marking is finished I ask them if they are happy with their results. I ask them if they know what a 'score' and 'dozen' are, and suggest they might have learnt something new today. I give a positional statement (e.g. the person at the back, closest to the sink) to the class so they can work out who to hand their books to. I ask a table of children to hand out textbooks. While this is happening two students come to me at the front to ask questions.

6:

7: I give instructions for page 54 of the textbook. I explain that the equipment on the desks is there for the lesson. I explain how the children are to rule up their grid books to make a Place Value Chart. I say that it should look like the Chart on page 54 in the textbook. I notice some children are doing it free hand and say "use our rulers please".

8:

9: I explain that today they need to do some thinking, showing, and writing. One of the textbook questions is 24 + 7 (a question everyone in this class can do easily in their heads). I explain to the children that I know they can do these easily, but that the textbook is looking at them understanding place value and using MAB blocks. I explain that they don't need to use numbers on their Place Value Charts, just MAB blocks. I walk around talking to the students and looking at their attempts on the Place Value Chart. I say "the point is not getting your questions right, but to know what you are doing". I demonstrate on the board by drawing MAB blocks on a Place Value Chart and explain this is what they should have done with their blocks on the chart. I walk around checking what they have done. I say to a child "Regan, that's a really bad decision" (in regard to his behaviour). I then demonstrate on the whiteboard how we trade with MAB blocks, asking students questions like "what are we going to do?". I trade and then I say "when you've done that move it underneath the line (where the answer goes), that's now your answer".

10:

11: I instruct the children to do the other questions on the textbook page in the same way in their grid books using the Place Value Chart they have drawn. To clarify that they understand what they are required to do (not just add the answer up in their heads and write it in their textbook) I say "when you do the others do you have to use the blocks?" A lot of the children respond "yes". I demonstrate on the board again, asking questions to get the students helping me and showing their understanding. I focus on trading.

12:

13: As they start on the page I say "it's not about getting them right, it's about understanding trading, I know the questions are easy but a challenge is coming". I walk around the room looking at student's work, asking individuals how they are going. Jamie asks a question about Question 8, I go to the board to demonstrate and explain asking Jamie for help. The question is 3 + 58. Jamie can get the answer 61 but has trouble trading. I ask him if it makes sense now, he seems happy. Other students are busy completing the activity using MAB blocks. I notice another child having trouble and explain how to use the Place Value Chart to him. When I have explained to him I say to the class "you can use mental strategies to do these problems" and verbalise some possible strategies. I then go on to explain that when numbers get larger, adding vertical columns and trading can be helpful.

14:

15: Jean asks a question further down the text page and I answer his question. Tam asks for help and I go to his seat and watch him as he completes the activity. Sasha asks for help and I go to his seat and help him.

16:

17: As I'm walking around the room several children come to me to show me what they have done. I hand out extra MAB blocks as some children do not have enough. I then write the challenge up on the board.

18:

19: I get the children's attention by putting my hands into the air, most children respond by copying me, being quiet and looking at me. Some people are still unsettled I say "who's speaking? Very bad manners!" The rest of the children are quiet. The challenge is a vertical addition problem where some numbers are given and other numbers have been replaced with empty boxes. In the first line there is a 1 in the tens column and a box in the units column. In the second line there is a 3 in the tens column and a box in the units column. A horizontal line is drawn under line two. In the answer line there is a box in the tens column and a 2 in the units column. I explain that the challenge is to be completed in their grid books and that there is more than one possible answer.

20:

21: The children begin their work and I walk around checking and answering questions. Two students get an answer quickly and I encourage them to find more. I respond to children asking for help, and help students who obviously are unsure what to do. Another child asks me a question and I say "hands in the air please, I have been asked this question a few times so you might need to know it too, the answer to this question will not be what is under the line, it will be the whole thing. Mrs Forrester doesn't know the answer; I am looking for some help when we look at possible answers". I encourage them to find as many different answers that work as they can.

22:

23: I challenge one child who has a group of solutions giving the answer 42, to find problems with the answer of 52. I say to a group of students not sure how to approach it "a sum that makes sense". I give several explanations to different children. Students are generally busy, I continue walking, watching, questioning and answering questions. I say "There are no tricks, maths doesn't have tricks".

24:

25: I get the children’s attention by putting my hands in the air then on my shoulders, in the air etc. until all the children are quiet. I challenge the class to find the solutions for 52. The children continue on with their work.

26:

27: I ask two children who have enthusiastically found a number of solutions how many they have found. Paige has found five and Jean has found seven. I suggest they check that their solutions work.

28:

29: I tell the class that they have another five minutes and continue walking around looking at work, correcting problems etc. Jean says he has eight solutions and I ask the class if anyone has more than eight solutions. I tell them they have four more minutes. I say "maths makes sense, so check that your answers make sense". I walk around talking with individual students. I say "I'm going to add to the challenge, are there any solutions that get the answer 62? I continue walking, and say "I can see Wynne is doing… well today". Wynne smiles (Wynne sometimes has problems staying on task). I talk to Brooklyn about his solution. I say to the class they have two more minutes.

30:

31: Jean says he can't get 62 and I suggest he should work out why. Paige says he can't get 62 either, both Paige and Jean talk about possible reasons.

32:

33: I say "eyes this way 1, 2, 3…Regan, really quick, thank you, excellent. Jaden are you ready?"

34:

35: The children swapped their books and marked the text questions. This was done by asking individuals to share their answers. I give positive responses like "yes… excellent… correct… that's right" etc. If the answer is incorrect I say "no" and redirect the question. The purpose of this was to mark the books quickly (this is one of those things I have had to change since I have been teaching a class full-time, because I simply do not have the time to mark everything myself. While this takes time from providing other learning experiences, it does provide children with the opportunity to see where they went wrong. Because of the number of questions to be marked it is not possible to give the children time to justify their solutions to every question. I do pick questions to do this with. In today's lesson all the children would have had very little difficulty getting correct answers, it was the trading experience that I felt was important. But the books need to the marked regardless, it is a school requirement that nothing goes home unmarked. As far as I am aware it is also a Board of Studies requirement).

36:

37: I give a statement for the children to work out who to give their books to (e.g. person with the 46th toe). I ask the children to come to the floor with their grid books, I give them a limited time to do this by saying "10, 9, 8,…".

38:

39: I start the sharing session with a question "Is making errors in maths a bad thing? ...(Children respond with "no")...if you learn something"…I go on to say "maths makes sense" and ask the children how we will know if a solution makes sense? They respond with checking other children's solutions. I write up on the whiteboard eight copies of the question. I talk about what I expect when children put up their answers. Students are selected to go up and write a solution, while the other students are asked to check if the solutions are correct. I say "if you see one that doesn't make sense please come out and make it makes sense". Children are getting up and putting up solutions or changing solutions. "Jean changed one, was he right or wrong? You need to check it out". "I can see one that doesn't make sense, can you see it?" Children go and fix them up and add more solutions. Children are talking amongst themselves and making comments.

40:

41: I say "What did you need to do to solve this problem?" The children respond with saying they needed to find numbers that add up to 2 (0, 1, 2). If they did that their answers would be 42. They could use bigger numbers that add up to 12, if that happened the solution would be 52. While this discussion is happening some children are distracted. I say "Excuse me guys up the back, I think you're being rude". We go on to talk about what numbers add up to 12, why we couldn't use 2 and 10 in the units column. I demonstrate on the board why this is so. We talk about why 62 was not a possible solution, with children making suggestions, and I repeating and clarifying what they have said. We found ten solutions. I say "you did really well, I'm very impressed". I direct the class in packing up.

42: **General notes:**

43: Again I seem quite stilted when the lesson started, but as the lesson progressed I became more relaxed. Maybe this is a combination of the activity and being videotaped.

44: My classroom control seemed to go well. Students settled quickly. The hand activity and 1, 2, 3 worked quickly. A warm relationship with students seems to come across, most students seem okay about sharing their answers on the whiteboard.

45: I find it a struggle emphasising the process rather than the answer and then reading out answers. In this case it was because the problems in the textbook were easy to answer for most students (this is the top mathematics class in Year 4) using ‘counting on’ or other basic strategies, but the focus in the textbook was on trading. Because the students would have no trouble answering these questions without trading I structured the lesson so they were required to trade not only with numerals on a page but with MAB Base 10 blocks. Therefore, the reason for marking the textbook page was not to ensure they had correct answers, so the children did it themselves quickly while I read out the answers. As I said in my notes, I usually ask one or two students to show solutions for some of the questions on the page, but not today. I have found marking to be a huge chore this year. For survival I must get the children to be part of this, it takes me forty minutes to one hour, on average, to mark one page. I just don't have time. I know there are benefits to the children marking their own work in terms of being a learning experience, but often on these pages there is just so much to mark that we don't have time to share our responses and justify our solutions in a worthwhile way.

46: A few themes in my teaching in mathematics came up in the videotaped lesson. I often emphasise “maths makes sense” and “maths isn't about tricks” and “making errors in maths is not a bad thing, we can learn from them” and "I'm interested in how you are doing it rather than if you get the right answer". These are regular themes that come up in my mathematics teaching.

47: I started to use ‘position’ statements when giving directions about book collecting. The students seem to like it and it gives them ‘real life’ experiences to utilise position language.

48: When watching the video I was unhappy (cringed) to see students obviously not getting the point about using MAB blocks when they could more readily and easily use mental strategies to solve the problems. This is the result of the required use of the textbook, and my inexperience, the emphasis on the use of a formal algorithm and my insecurities about my students needing to have a thorough knowledge of the algorithm and trading. I wish this could come from necessity (child directed) but I'm not confident enough of how to go about it. May be tougher questions where an algorithm would be beneficial in answering it will be the way to go. Obviously the textbook introduces the formal algorithm using simple problems for good reason (I know some of my students struggled with trading with the simple questions, they would really have struggled with more difficult questions. However some of my students would have seen the benefit of a formal algorithm with more difficult questions and had no trouble utilising trading). I chose the challenge to keep the numbers manageable (they could not get too big) but the nature of the question gave the children a reason to trade, although this was not necessary. Many students used MAB blocks to trade and test possible solutions, some were trading with the numerals only, others were using other mental and physical strategies (counting on).

49: I find a problem in this ‘discovery’ learning in providing appropriate opportunities to ‘discover’. Some of these students will happily use mental strategies for all of these questions without recognising trading, even if they do it. My insecurities about covering the course adequately (especially for exams and progression) come to the fore.

50: I was happy that I allowed a reasonable amount of time to share solutions, although some of this was very teacher directed. I find this part challenging as these students (like Year 2 in 2002) struggle listening to other students. I need to keep working on this, as I feel like this sharing time loses some children's interest, usually the ones who would benefit most.

Video Notes Year 4 - 25.9.03

1: **Note**: All names except those of my family are pseudonyms.

2: **Lesson notes Year 4: 25.9.03 Term 3 Week 10**

3: I get the children's attention by placing my hands on my head, hips, desk (the children copying me). I explain the videotaping and respond to questions. I tell them we are about to start the speed test and say "I'm about to start timing 5, 4, 3, 2, 1 go". The speed test is started and the children follow the normal routine. I walk around the room watching the children, I then tell them to put their pens down at the end of one minute. We then start another sheet, again I count down "5, 4, 3, 2, 1 off you go". This too lasts for one minute. I say "pens down, swap with a neighbour". I wait for about 15 seconds then start to read out the answers to the six times table speed test (Sheet 1 was multiplication facts, Sheet 2 was the division facts of six). I then gave a position statement (something like "the person with the 36th toe") for the children to give their sheets to at each table. I say "you need to be on the floor quickly".

4:

5: The text pages for today are pages 136, 141, 142. The children who go to G & T come back into the room with their results from their recent G & T activity, they share these with me and I congratulate them.

6:

7: The next part of the lesson has me doing a lot of talking about Volume. I revisit previous experiences where we looked at one litre. I explain that today we are going to look at volumes less than one litre. I show the group a box of soy milk (full) and a container which normally holds ice cream (empty). We joke about there being no ice cream. I hold up different containers of different shapes and sizes. I talk about how some containers hold the same amount even though they look totally different. We read the amounts written on several different containers and I ask the class why some are measured in millilitres and others are measured in litres (why 1000 millilitres is referred to as 1 litre). Children give suggestions and I confirm that the litre measurement is used for bigger things and the millilitre measurement is used for smaller things. I asked them why some containers measure their contents in grams and kilograms rather than litres or millilitres (yoghurt was measured as 1 kg, ice cream was measured in litres). Children suggested one was measuring volume the other was measuring weight (mass). I ask them if they think 1 kg is the same as one litre. After some discussion I verbalise the suggestions of a few children that 1000 mLs seems to be the point where we measure in litres. I respond to a question regarding whether mLs and millilitres are the same.

8:

9: I talk about measuring medicine in small amounts and talk about the need to be precise when measuring something like medicine (how dangerous it might be to estimate). I show them eye droppers and ask them to estimate what they think one would hold (estimates vary between 1 and 50 mLs). I ask the same for a teaspoon (estimates vary from 5 to 10 mLs, one child says "136 drops of water" which he tried at home). I give the challenge to the children to find out how many mLs are in a teaspoon. I demonstrate that an eye dropper has less than two mLs. I tell them they will have a go at trying all of the equipment and measuring devices. I tell them I hope they get a feel for how small 1 mL is. I tell them their challenge is to find out how many mLs in a teaspoon and to use the equipment to complete the pages in their textbooks. I describe how they need to 'calibrate' a measuring container by writing on it with a texta to show 10 mLs.

10:

11: I suggest to the class some precautions, I say "water and books don't go very well together, let's be sensible (noisy giggles) mouths closed 1, 2, 3". I tell them they need to work as a group and that I will be looking for the best co-operating table to give a lolly reward. I dismiss the children to their tables. The class becomes noisy and I say "mouths closed eyes this way 1, 2, 3. Noel, brilliant, name on my smile".

12:

13: I call out some students to complete a test they began yesterday, or missed out on because they were away. (There is a lot of outside noise due to a gardener using a vacuum blower outside our room). I ask the students to work quietly while I organise those completing tests. A lot of children are asking questions, and I am feeling stressed trying to organise a very active lesson and the completion of a test for some students. I ask the students to do part of the text pages that don't require equipment until I can hand the equipment out. I finish organising the test people then hand out the equipment. I organise students into groups and answer children's questions. Students are generally working well in their books either at their desks or on the floor. I help students by showing them how to fill the eye droppers. I walk around the room making sure students are on task and helping those that have questions or difficulties. Some equipment is limited in number so I rotate groups to this equipment. I continue answering questions and asking questions to clarify students' understandings.

14:

15: I ring a small bell to gain students' attention and continue rotating children, enabling groups to use the eye droppers. I continue to watch, ask questions etc. I changed groups again. I answer several students questions. Some students are not on task, they are showing off for the camera (while I'm not looking).

16:

17: I tell children to pack up and come to the floor. Children pack up containers. After a few minutes I start to count backwards from 10, while walking around, organising the cleanup. I sit down at the front and say "mouths closed please". I seem calm despite the fact that several students are unsettled and a bit noisy. I begin a discussion; I say "tell me… I'm sorry I'm not going to compete with that". The child is heard to say sorry. I say "thank you". I initiate a discussion about how much a teaspoon holds, some children are still noisy and unsettled I say "I don't know where your manners have gone today, find them…". The children share their results, there is a wide range of answers. I say "what could we be doing differently to give such different results?" A student replies "measuring wrong". I talk about precision. The class agrees that 1 mL is very small. I say some encouraging things like "you did a good job today" etc.

18: **General Notes:**

19: The students are very settled and quick at speed tests. They have become very familiar with the routine of getting ready for them, completing them, marking them and collecting them.

20: My efforts at getting the students' attention was good despite this being a very busy, unstructured lesson. When viewing the video I became aware of students playing up for the camera. I did not see this when I was teaching and so I was surprised to see some students off task for extended periods.

21: The rapport with the class was generally good.

22: The introductory session for volume was very teacher directed again. I find it very hard to let things be discovered and discussed. I need to work on this. I suspect it takes very precise planning about the sorts of things I might ask the children as well as the tasks I set them. I simply do not have more time to plan my lessons. I am very time poor, exhausted frankly.

23: I find measurement activities are very active even using a textbook. The problem with the textbook is that it often specifies equipment that I can't get.

24: I feel I handled a very unstructured lesson quite well, helping, answering questions, asking questions, getting people on task, organising people etc.

25: I think the closing time could have been more worthwhile if I had focused more on the notion of 'precision'. I needed to get the children to show what they had done to get their results rather than simply tell them what the problems might be.

26: In this lesson there were three text pages completed by the children. I had to mark the pages myself as there was often no right or wrong answer and it was impossible to mark as a class.

27: I started adding multiplication (to position statements) tasks so that children could work out the person to collect the books at each table. Students have enjoyed this.

Video Notes Year 4 - 4.12.03

1: **Note**: All names except those of my family are pseudonyms.

2: **Lesson notes Year 4 2003: 4.12.03 Term 4 Week 8**

3: I give directions for the students to get ready for their speed test. Today the task is written on the whiteboard and the children have to set up a page in their grid book, this takes some children a long time and I talk to two children individually by name to stay on task. I time them in saying "5, 4, 3, 2, 1 go". I watched the class and the clock. I tell them to put their pencils down and to swap their books to mark. The test today is on division facts from various multiplication tables. I read out the questions and the answers (the questions are set out on the board like this [picture of long division sign] . I ask them "who found that tough? You needed to be asking yourself a multiplication question like 7 multiplied by what equals 49? 7 x 7 = 49". While talking like this I say "please don't do that Drew".

4:

5: I tell them we are going to do some more of the problems we commenced yesterday (these problems are generally non-routine). I hand out a sheet and read out a question. I interrupt to say "Excuse me, you should not be talking". Children have difficulty understanding what is required. I demonstrate the question on the board. The question requires the children to rule a straight line cutting the clock face in half where the numbers on one half total the same as the numbers on the other half. One child says "it's impossible". I say "it is not impossible or they wouldn't be asking you to do it". More questions are asked regarding the nature of the question, I respond by drawing a line on the clock face in a position that could not possibly be correct (where one half of the clock has most of the small numbers, the other half having most of the large numbers). I mention that I suspect this one might not work due to this fact.

6:

7: I still get questions about the nature of the question. I respond to one of them, telling the child that you don't draw a line through the number, but on either side of the number, I tell the class that we are not drawing the time on the clock face. Someone asked about the necessity of putting the line in a place that cuts the clock face in half, I respond that the two sides had to have the same number of numbers as each other. I demonstrate an obviously incorrect answer, adding each number onto the previous total out loud, but some children still have problems understanding what to do.

8:

9: Some children have completed the task, so while we wait for the majority of children to finish it I suggest they go on and complete the problems they began yesterday until we come back to this problem. I walk around the room answering questions and seeing if the children understand what to do. There is a lot of noise, but it is busy noise, though some children are performing for the video (waving etc.). I walk to the whiteboard and in response to a student's question I do some calculations regarding the problem. I walk around the room and continue looking at students working. To get their attention I say "okay now eyes this way 1, 2, 3… well done guys… I could see a lot of…. thinking going on…".

10:

11: I ask Brooklyn to come to the board and show his solution. I say "guys Brooklyn deserves your respect that means you'll be listening". Brooklyn draws a line on the clock face, I add up the numerals on each side of the line out loud. Two students come out of their seats to speak to me while the class should be listening and watching. I tell them to go back to their seats. I continue counting and find that Brooklyn's solution works.

12:

13: I give the children the next challenge which is to find where the line might go so that the numerals on one side total half the sum of the numerals on the other side. I show the class how I worked out the total of all the numerals on the clock and divided the total by three to get 26. I say I'll have a go at finding a solution too. I say to a disruptive student "Stevie you're doing the wrong thing (I put his name under the frown), I wonder who might join him if they're talking in class discussion time". I then say in response to a disruptive noise "whoever is making that awful noise stop it now". The noise stops.

14:

15: The class goes on to the next problem on the sheet. It requires them to fill in boxes with the numerals 1 to 9 without putting consecutive numbers in boxes that touch each other. I demonstrate what they are to do on the whiteboard (not the solution but what the question is asking them to do). Most students are on task, after a few minutes a student asks "Has anyone got it yet?" I reply "No, every time they get close they get stuck at the last bit". Students come to me while I am walking around the room showing me their solutions, I check them, most of them are incorrect, and they go back to try again. One child gets a correct solution, he jumps up and down. Children continue coming to me as I walk around the classroom. After a few minutes I say "eyes this way, sitting in your seat, 1 2…", the room goes quiet.

16:

17: I ask the child who was first to come to me with the correct solution to come and fill out his solution on the board. I tell the children to check it with me to make sure I haven't made a mistake. I go through this solution with the class. I ask if anyone has a different answer. Several children respond that they do. I call Ally to write out his solution, he says it is only a little bit different, and puts his solution on the whiteboard. I say "I suspect it is right, can anyone tell me why?". Several children say "because they're [the numerals] just back the front". Another student comes out and writes up his solution, I am checking it in my head, some students are doing the same, and we find it does not work. I rub it out, call the class to attention again, and another child puts up a solution. In writing it on the board the child makes a mistake, picks it up, corrects it and checks it. I check it, modelling what I am doing in my head out loud. More students come up and write on the board showing their solutions I say "Well done guys, I think we've got all the possible solutions".

18:

19: I then tell them we are going to look at some of the solutions from yesterday's problems. One question asked children to find three numbers that add up to 45, where the second number is 5 bigger than the first number, and the third number is 5 bigger than the second number. I ask Andie to share his solution to the first question, some people are distracted a noisy, I say "I'm sorry people are not paying attention, very rude". Noise settles. I ask Andie again but he has not got a solution and says he did not understand the question. Jean offers a solution of 10, 15, 20, I say "they are certainly 5 more than each other, do they add up to 45? I add them up out loud and say they are correct.

20:

21: I read out the second question and ask Andie if he has a solution to that, two children are out of their seats I say "Tam and Coby I don't know why you are out of your seats, but you do not have permission to wander around the room" (I put their names under the frown).

22:

23: The third question is looking for how many rectangles are in a shape. I ask for children's solutions, the most rectangles found is 14. I tell them there are even more solutions. I call out students individually to come to the board and trace a rectangle using a coloured whiteboard marker. I tally each one we find using tally marks on the whiteboard. Students have their hands up volunteering to participate. I look at the shape and ask myself out loud "is there another one? Yep I can still see another one". A child challenges the notion of rectangles sharing common sides, I respond by explaining that each is still a rectangle and showing them on the board and say "but good thinking". Tam and Coby are not participating but being disruptive I say “I'm sorry but it seems that will be spending lunchtime with me...” (putting a cross next to their names). Brooklyn is crying in the corner of the room, I ask what is wrong, he has been hurt. I say "you poor old thing" and make sure he's alright.

24:

25: I read out the next question and clarify what it means. It details the possible combinations someone might select for lunch, including the main food, a piece of fruit and a drink. I say "Let's see, some people to give me some possibilities of all the lunches they could have". I ask if anyone hasn't had a go at giving a solution to the class today. I give some possibilities (not the students), and I say "Any others, what would you do next?" A child responds, I say "Alright" and continue. I say "Any other possibilities I haven't picked up?" No responses from the children, I look at the answer in a book. The child asks me a question and I clarify the problem. The class is noisy. I say "Okay hands in the air… thank you, hands down". The noise settles.

26:

27: I read out the next question, quite a few of the children haven't done it, so I give them a minute to have a go. The question asked them to find two numerals where the answer to their addition is the same as the answer to their multiplication. I walk around the room responding to people's comments and questions. I ask a child why he's on the opposite side of the room to his chair. I ask him if he is ready to share his answer, he says he has not done it. I say "No? How embarrassing, no answer and doing the wrong thing". I put another child's name on the frown for talking and not working.

28:

29: I read the next question, a child gives an answer and an explanation. I give them a minute to try the question and walk around looking at their working.

30:

31: I get the class's attention and ask if Quincy has a solution. I ask him to explain it to the class it but interrupt because of unsettled classroom behaviour, I say "Oh I'm sorry, mouths closed". Quincy calls out his answer, I work it out in my head, say that his solution works and put the answer on the board. A child challenges it and shows how it doesn't work. Another solution is given, I work it out loud and say "That works, well done".

32:

33: I give instructions to the class about marking and pasting their sheets in their grid books and give a statement for the children to work out who to give their books to. I say "hand your book to the person with the 47th eyebrow". Students count around the people at their desks by twenties to work it out. I ask the children to come to the floor and say "Tam let's see how quickly you get to the floor, hopefully you won't be with me for lunch…Andie come and rub your name off, you are sitting quietly".

34:

35: The children sit in a circle to play "around the world" using the seven times table to begin with. One child makes a rude comment about a child who is winning the game I say "If I hear that one again you'll be in trouble". The children are very excited and it is hard to continue with the game when the participants cannot hear me give the questions, I say "This isn't much of the game guys when I have to keep quietening you down". While the children are playing I am paying particular attention to the children whose names are under the frown in an effort to rub them off (to avoid them having a lunchtime detention). I keep having to settle the children to give the next question. We go on to questions from several different multiplication tables, and continue the game until everybody in the circle has a turn and we have a winner. We clap the winner. I quieten the children again and bring the lesson to a close.

36: **General Notes:**

37: This lesson was all 'problem solving' using non-routine problems. I think it went quite well, most students were actively involved and keen.

38: My rapport with the class was relaxed, yet I had good classroom control. Even in the game at the end the children would respond quickly to a call to be quiet. I don't know if I can set up games to be more structured or less noisy, it seems to be part of a game. Children get excited which is good. I always have a niggling feeling with this type of game that it really benefits the children who know their tables other than giving practice to the children who don't. But this is the more able class and the students get daily tables practice at home (homework) and school. I don't think I would play it with a less able group unless the tables were written on the wall.

39: I still take a very controlling role in discussion time. I know I do this because, from experience it takes a lot of time to get children to do a lot, and other children get bored more quickly. I need to work on it anyway, especially in setting classroom expectations.

40: I was happy with my response to a nasty comment made to a child who was winning the game. At that time he was competing with some of the 'cool' children and winning. I work hard at making the room a safe place to make mistakes and have a go.

41: I probably gave too much help with non-routine problems. The questions I answered were mainly to do with clarifying the problem but I had to show possible solutions to do this. This is due to the fact that the children are still not really familiar or comfortable with this type of question.

42: Group work wasn't structured but children worked with friends or individually to come up with answers.

43: I find mathematics is very competitive for a handful of children who want to race to finish quickest and get the right answers. While I don't want to quell their enthusiasm this can make it unsafe for others. I have worked hard at making sure this is dealt with positively but I am not convinced I am succeeding.

44: I had moments where mathematics thinking was acknowledged but right/wrong answers were still a focus.

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