Perceptions of student teachers and practising primary teachers in relation to primary mathematics

Thambiaiah Kalamany
University of Wollongong

UNIVERSITY OF WOLLONGONG
COPYRIGHT WARNING
You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site. You are reminded of the following:

This work is copyright. Apart from any use permitted under the Copyright Act 1968, no part of this work may be reproduced by any process, nor may any other exclusive right be exercised, without the permission of the author.

Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

Recommended Citation

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au
PERCEPTIONS OF STUDENT TEACHERS AND PRACTISING PRIMARY TEACHERS IN RELATION TO PRIMARY MATHEMATICS

A thesis submitted in partial fulfilment of the requirements for the award of the degree

DOCTOR OF EDUCATION

from

UNIVERSITY OF WOLLONGONG

by

Thambiaiah Kalamany

Bachelor of Science (Special) (University of Peradeniya, Sri Lanka)
Post Graduate Diploma in Education (University of Jaffna, Sri Lanka)

Faculty of Education
2002
# Table of Contents

Abstract
Acknowledgements

**Chapter 1 — Introduction**
1.1 The Background to the Study 1
1.2 Purpose, Aims & Research Questions 7
1.3 The Significance of the Study 8
1.4 Locus of the Study 10
1.5 Structure of the Study 13

**Chapter 2 — Review of Literature**
2.1 Introduction 16
2.2 Theories of Teaching and Learning 17
2.3 The Nature of Mathematics and Teachers Beliefs about Mathematics, Mathematics Teaching, and Mathematics Learning 26
2.4 Teacher Change 36
2.5 Conclusion 41

**Chapter 3 — Methodology**
3.1 Introduction 42
3.2 Rationale for using the Naturalistic Paradigm 44
3.3 Research Design 47
3.4 Site and Participants 51
3.5 Data Collection Procedures 53
3.6 Data Analysis 62
3.7 Quality of Data 66
3.8 Conclusion 68
## Chapter 4 — Analysis of the Questionnaire Data

4.1 Introduction 69
4.2 Personal Characteristics 70
4.3 Mathematics Background and Training 80
4.4 Beliefs and Classroom Practice 88

#### 4.4.1 Nature of Mathematics 88

#### 4.4.2 Mathematics Curriculum in NSW 94

#### 4.4.3 Mathematics Teaching Strategies 105

#### 4.4.4 Training for a Competent Mathematics Teacher 112

#### 4.4.5 Enthusiasm for Teaching Mathematics 117

#### 4.4.6 Working Environment 120

#### 4.4.7 Mathematics Teaching, Mathematics Learning and its Assessment 123

#### 4.4.8 Grouping during Maths Lessons 126

#### 4.4.9 Assessment of Mathematics Learning 128

#### 4.4.10 Resources for Learning 131

4.5 Summary of Main Findings 136
4.6 Conclusion 140

## Chapter 5 — Analysis of Qualitative Data 141

5.1 Introduction 141
5.2 Background and Setting 141
5.3 An Overview of the Analytical Process 142
5.4 Construction of Coding Categories 143
5.5 Beliefs, Attitudes and Perceptions about mathematics 146

#### 5.5.1 Beliefs about the Nature of Mathematics 147

#### 5.5.2 Beliefs about Mathematics Education, Mathematics Teaching and Mathematics Learning 150

#### 5.5.3 Teacher Perceptions of Influences on Beliefs about Classroom Practice 161
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5.4 Teacher Perceptions about External Factors Inhibiting Change</td>
<td>171</td>
</tr>
<tr>
<td>5.5.5 Student Teacher Perceptions about the Preservice Programs</td>
<td>177</td>
</tr>
<tr>
<td>5.5.6 Perceptions about the NSW Curriculum and Policy</td>
<td>180</td>
</tr>
<tr>
<td>5.6 Summary of Main Findings</td>
<td>187</td>
</tr>
<tr>
<td>5.7 Conclusion</td>
<td>189</td>
</tr>
<tr>
<td><strong>Chapter 6 — Discussion and Recommendations</strong></td>
<td>190</td>
</tr>
<tr>
<td>6.1 Introduction</td>
<td>190</td>
</tr>
<tr>
<td>6.2 Background of Participants</td>
<td>191</td>
</tr>
<tr>
<td>6.3 Beliefs about Mathematics, Mathematics Teaching and Mathematics Learning</td>
<td>192</td>
</tr>
<tr>
<td>6.4 Influences and Constraints on Classroom Practice</td>
<td>202</td>
</tr>
<tr>
<td>6.5 Recommendations for Further Research</td>
<td>207</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>212</td>
</tr>
<tr>
<td>Appendix A: Participation Information Sheet</td>
<td>221</td>
</tr>
<tr>
<td>Appendix B: Consent Form</td>
<td>222</td>
</tr>
<tr>
<td>Appendix C: Student Teacher Questionnaire</td>
<td>223</td>
</tr>
<tr>
<td>Appendix D: Teacher Questionnaire</td>
<td>228</td>
</tr>
<tr>
<td>Appendix E: Semi-structured Interview Questions — Student Teachers</td>
<td>236</td>
</tr>
<tr>
<td>Appendix F: Semi-structured Interview Questions — Teachers</td>
<td>237</td>
</tr>
<tr>
<td>Appendix G: Bachelor of Education Mathematics — Subject Structure</td>
<td>239</td>
</tr>
<tr>
<td>Appendix H: Excerpt from Interview with SP2</td>
<td>240</td>
</tr>
<tr>
<td>Appendix I: Excerpt from Interview with S41</td>
<td>250</td>
</tr>
<tr>
<td>Appendix J: Excerpt from Combined Coded Interview</td>
<td>255</td>
</tr>
</tbody>
</table>
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Contrasting positivist and naturalist axioms</td>
<td>45</td>
</tr>
<tr>
<td>3.2</td>
<td>Structure of the study</td>
<td>63</td>
</tr>
<tr>
<td>4.1</td>
<td>Distribution of the sample among year levels — Student Teachers</td>
<td>70</td>
</tr>
<tr>
<td>4.2</td>
<td>Distribution of the sample — Student Teachers</td>
<td>70</td>
</tr>
<tr>
<td>4.3</td>
<td>Composition of the sample by sector and by location — Practising Teachers</td>
<td>71</td>
</tr>
<tr>
<td>4.4</td>
<td>Age distribution of the sample — Student Teachers</td>
<td>72</td>
</tr>
<tr>
<td>4.5</td>
<td>Distribution of the sample across age range — Student Teachers</td>
<td>72</td>
</tr>
<tr>
<td>4.6</td>
<td>Age distribution of the sample by year level — Student Teachers</td>
<td>73</td>
</tr>
<tr>
<td>4.7</td>
<td>Age distribution of the sample — Practising Teachers</td>
<td>73</td>
</tr>
<tr>
<td>4.8</td>
<td>Gender distribution of the sample — Student Teachers</td>
<td>73</td>
</tr>
<tr>
<td>4.9</td>
<td>Gender distribution of the sample — Practising Teachers</td>
<td>74</td>
</tr>
<tr>
<td>4.10</td>
<td>Composition of the sample by status — Student Teachers</td>
<td>76</td>
</tr>
<tr>
<td>4.11</td>
<td>Positions held in schools — Practising Teachers</td>
<td>76</td>
</tr>
<tr>
<td>4.12</td>
<td>Distribution of educational qualifications — Practising Teachers</td>
<td>77</td>
</tr>
<tr>
<td>4.13</td>
<td>Current year levels of Practising Teachers</td>
<td>78</td>
</tr>
<tr>
<td>4.14</td>
<td>Distribution of teaching experience of Practising Teachers</td>
<td>79</td>
</tr>
<tr>
<td>4.15</td>
<td>Employment experiences of Student Teachers</td>
<td>79</td>
</tr>
<tr>
<td>4.16</td>
<td>Highest level of study of high school mathematics</td>
<td>80</td>
</tr>
<tr>
<td>4.17</td>
<td>Level of study of high school mathematics</td>
<td>81</td>
</tr>
<tr>
<td>4.18</td>
<td>Level of study of high school mathematics by age group</td>
<td>82</td>
</tr>
<tr>
<td>4.19</td>
<td>Emphasis on mathematics in preservice program</td>
<td>83</td>
</tr>
<tr>
<td>4.20</td>
<td>Perceptions about adequacy of mathematics training in preservice</td>
<td>84</td>
</tr>
<tr>
<td>4.21</td>
<td>Need of more time allocation in preservice program</td>
<td>86</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.22</td>
<td>Teacher comments about the time allotted to mathematics</td>
<td>87</td>
</tr>
<tr>
<td>4.23</td>
<td>Distribution of Student Teacher and Practising Teacher responses to belief statements</td>
<td>90</td>
</tr>
<tr>
<td>4.24</td>
<td>Distribution of Student Teacher responses at different year levels</td>
<td>92</td>
</tr>
<tr>
<td>4.25</td>
<td>Student Teacher and Practising Teacher Responses to 10 belief statements about NSW Primary Curriculum</td>
<td>96</td>
</tr>
<tr>
<td>4.26</td>
<td>Summary of significant Chi Square analysis for status of participants on the belief statements about the curriculum in NSW</td>
<td>98</td>
</tr>
<tr>
<td>4.27</td>
<td>Student Teacher responses to 10 belief statements about NSW Primary Curriculum</td>
<td>101</td>
</tr>
<tr>
<td>4.28</td>
<td>Summary of significant Chi Square analysis for different year levels of Student Teachers on the belief statements about the curriculum in NSW</td>
<td>103</td>
</tr>
<tr>
<td>4.29</td>
<td>Distribution of frequencies for the use of different teaching strategies</td>
<td>107</td>
</tr>
<tr>
<td>4.30</td>
<td>Summary of Chi Square analyses on the preference to teaching strategies</td>
<td>110</td>
</tr>
<tr>
<td>4.31</td>
<td>Summary of significant Chi Square analysis for status of participants on the preferences to teaching strategies</td>
<td>110</td>
</tr>
<tr>
<td>4.32</td>
<td>Summary of significant Chi Square analysis for year level of Student Teachers on the preferences to teaching strategies</td>
<td>110</td>
</tr>
<tr>
<td>4.33</td>
<td>Distribution of frequencies for the kinds of training the participants felt needed</td>
<td>113</td>
</tr>
<tr>
<td>4.34</td>
<td>Summary of Chi Square analyses on the preferences to kind of training</td>
<td>115</td>
</tr>
<tr>
<td>4.35</td>
<td>Summary of significant Chi Square analyses for status of participants on the preferences to kind of training</td>
<td>116</td>
</tr>
<tr>
<td>4.36</td>
<td>Summary of significant Chi Square analyses for year level of student teachers on the preferences to kind of training</td>
<td>116</td>
</tr>
<tr>
<td>4.37</td>
<td>Practising Teacher enthusiasm for teaching mathematics compared to other KLAs</td>
<td>118</td>
</tr>
<tr>
<td>4.38</td>
<td>Teacher description of their level of enthusiasm for teaching maths</td>
<td>119</td>
</tr>
<tr>
<td>4.39</td>
<td>Time allocations for teaching mathematics</td>
<td>119</td>
</tr>
<tr>
<td>4.40</td>
<td>Teacher responses to the question How would you characterize the average ability level in your class in relation to the expected maths outcomes for their age group?</td>
<td>121</td>
</tr>
<tr>
<td>4.41</td>
<td>Teacher responses to the question How homogeneous in math ability is your class?</td>
<td>122</td>
</tr>
<tr>
<td>4.42</td>
<td>Teacher descriptions of typical math lessons — Sydney public school</td>
<td>123</td>
</tr>
<tr>
<td>4.43</td>
<td>Teacher descriptions of typical math lessons — Wollongong public school</td>
<td>124</td>
</tr>
<tr>
<td>4.44</td>
<td>Teacher descriptions of typical math lessons — Sydney independent school</td>
<td>125</td>
</tr>
<tr>
<td>4.45</td>
<td>Teacher descriptions of typical math lessons — Wollongong Catholic school</td>
<td>125</td>
</tr>
<tr>
<td>4.46</td>
<td>Grouping children during math lessons</td>
<td>127</td>
</tr>
<tr>
<td>4.47</td>
<td>Teacher responses to the question How often do you give homework in mathematics?</td>
<td>128</td>
</tr>
<tr>
<td>4.48</td>
<td>Teacher responses to the question In what other ways do you assess children's progress?</td>
<td>130</td>
</tr>
<tr>
<td>4.49</td>
<td>Teacher responses to the question Which of the following do you use in maths teaching with your class?</td>
<td>131</td>
</tr>
<tr>
<td>4.50</td>
<td>Teacher responses to the question Are you satisfied with the availability of resources in your school for mathematics teaching?</td>
<td>132</td>
</tr>
<tr>
<td>4.51</td>
<td>Most important maths teaching materials</td>
<td>133</td>
</tr>
<tr>
<td>4.52</td>
<td>Availability of computers for children's use</td>
<td>135</td>
</tr>
<tr>
<td>Figures</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3.1 Four possible ways that qualitative and quantitative methods might be integrated</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>3.2 Composition of the sample by gender- student teachers</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>
Abstract

This study explores beliefs held by student teachers and practising primary teachers about the nature of mathematics, the teaching and learning of mathematics, and their own classroom practices. The study aims to provide evidence of the relationships between these beliefs, the teaching of mathematics, and the influences and constraints on classroom practice.

The study is both quantitative and qualitative in design, using semi-structured interview as a main tool while supported and guided by an initial questionnaire survey. A cohort of 361 student teachers and 34 practising teachers responded to the questionnaire survey. The interview data were based on the beliefs of twelve student teachers in all four year levels of the B Ed program at Wollongong University and of twelve practising teachers from two schools of Sydney Metropolitan area and two in the Illawarra area.

The findings show coherence among the practising teachers beliefs and consistencies between these beliefs and their reported classroom practice. The study also found evidence for comparing student teachers beliefs and their perceptions about their preservice program, identifying significant differences of their beliefs from those of practicing teachers.

Finally, proposals are made for future study with reference to the preservice program in relation to mathematics curriculum and policy for schools and teacher professional development.
Acknowledgements

I wish to acknowledge the patience, encouragement, inspiration, and valuable guidance of Dr Christine Fox and Dr Michael Wilson who have been my supervisors for the entire period of this study. I am greatly indebted to them for the generous support and advice they have provided over three years of this study.

To the staff of the Faculty of Education, Wollongong University, especially the Dean and the teaching staff, I owe a great deal as it was the support from them that encouraged me to continue my research.

In addition, in particular, to the participant student teachers and practising teachers, and to the principals of their schools, I give a sincere thank-you.

I am also indebted to Professor P. Balasundarampillai, Vice Chancellor, University of Jaffna, for his continuous support to extend my leave on a number of occasions, and to Professor A. Sanmugadas, Dean of the Faculty of Post Graduate Studies, University of Jaffna and Professor K. Sinnathamby, Head of the Department of Education, University of Jaffna, who generously encouraged me through telephone conversations from Sri Lanka.

It is also my part to thank the Ministry of Education, Sri Lanka for the opportunity given and to the World Bank for its financial support.

Finally, I wish to acknowledge the tolerance and encouragement of my wife and children who have given up their wishes and enjoyment on several occasions to allow me to undertake this study, and to document the outcomes.
1.1 The Background to the Study

Mathematics is prevalent in all aspects of our lives. It provides important tools for use at the personal, civic and vocational level. ‘Mathematics for all’ has been of growing concern since ‘education for all’ became universally accepted as an essential prerequisite for human progress. Quantification, measurement, pictorial representation, graphical representation and making decisions when outcomes are in doubt, together with the common availability of devices which have removed the drudgery from calculation – all these considerations make it evident to all that no one should be unfamiliar with these aspects of mathematics and unable to use them. Accordingly, that all should receive instruction in mathematics is not in doubt.

Mathematics is one of the six Key Learning Areas (KLAs) that comprise the primary curriculum in New South Wales. ‘The Primary Purpose’ (1994), a curriculum document for primary school and their communities, states that students in every primary school in New South Wales must be provided with significant opportunities for learning in all of the six major learning areas in every year as they progress through the primary school. The minimum expectation of the primary school system about mathematics is to teach all students the basics of number, space and measurement with the development of basic mathematical competence for daily living and problem solving as its primary goal.
The learning of mathematics will mean the comprehension of those concepts and apprehension of their relationships together with their symbolisation, and the development of the ability to apply the resulting concepts to real situations occurring in the world. As mathematics involves a hierarchical building up of concepts, basic mathematical concepts have to be strongly reinforced by primary mathematics teachers.

Primary teachers of mathematics face many challenges in their classrooms. They are expected not only to comprehend mathematical concepts, operations, and reasoning themselves but also to develop that comprehension in their students. This latter task involves teacher decisions but is closely guided by the requirements of the particular syllabus used in the school in a particular school year. Educational policy plays a major role in determining the concepts and skills included in the curriculum, and is shaped by the needs of later levels of schooling and by the needs of future employers and the society within which the schooling is being carried out. Thus, a classroom teacher's amount of flexibility in choosing concepts and skills is limited. However, a classroom teacher's role in sequencing the content, in employing teaching strategies, in catering for the individual needs of children in the classroom, and in organising the classroom to use materials and technologies that are available, requires significant decisions on a daily basis (Mansfield, 1996). As Mansfield (1996, p.5) states, 'Each teaching decision is not made in isolation from other decisions the teacher makes and for teachers to maintain some coherence in their teaching, they need to set their decisions with their own framework of beliefs.' Consequently, a teacher's role in the classroom is an extremely complex one.

'Beliefs', 'attitudes' and 'perceptions' are all terms that are related and have influence on classroom practice. A belief can be defined as "any simple preposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase: 'I believe that ...'" (Rokebach, 1968,
Southwell (1993, p.293) describes a belief as "an idea which, when held determines the way the individual acts" and acknowledges "there is some evidence to believe that the beliefs which a teacher holds about mathematics affects the way in which mathematics is taught".

Although definitions of attitudes vary, they generally include the idea that attitudes manifest themselves in one's response to the object or situation concerned. One such definition states... 'attitude is a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related' (Allport in Kulm, 1980, p.356). Teachers' attitudes toward their work influence the way they implement educational policy. The attitudes of student teachers and practising teachers are of particular importance because of their potential influence on pupils. Also, an important aim of mathematics education is to develop in students positive attitudes towards mathematics and their involvement in it.

However, perceptions of student teachers and practising teachers about the nature of mathematics, mathematics teaching and mathematics learning encompass the beliefs and attitudes about mathematics and its teaching and learning. In specific terms, perception is not mere seeing but is connected with past experiences and present mental set up. It is 'the process of detecting a stimulus and assigning meaning to it', (Woolfolk, 2001, p.245). According to the Gestalt theorists, perception involves organised, meaningful wholes rather than perceiving bits and pieces of unrelated information (Woolfolk, 2001). Thus, teachers' beliefs and attitudes are constituents of their perception and it is important to explore the beliefs and attitudes in order to describe their perception.

All teachers of mathematics hold beliefs about mathematics, mathematics learning and mathematics teaching. These beliefs influence and guide teachers in their decision-making and in their implementation of teaching strategies.
(Baroody, 1987). Beliefs about how young children learn mathematics, the nature of mathematics, and the relationship of mathematics to other school subjects, are all important in making decisions on the mode of instruction in the classroom. The development of beliefs about the nature of mathematics and how mathematics is done 'are important not only because they influence how one thinks about, approaches, and follows through on mathematical tasks but also because they influence how one studies mathematics and how and when one attends to mathematics instruction' (Garofalo, 1989, p.502).

As teachers' beliefs play a major role in the teaching process, teacher education is today oriented towards the development of beliefs, knowledge and competence. Also, preservice teacher education students are likely to have acquired naïve beliefs about learning and teaching, that need to be integrated with theoretically informed beliefs. Accordingly, teacher beliefs in relation to mathematics education is currently being considered a significant area for educational research.

Further, education policy is formulated with the assumption that it will influence what happens in classrooms and schools. Yet, this influence will be effective only if the policy fits with the beliefs teachers hold about their work activities. There are numerous illustrations of how well intended educational policies result in unexpected outcomes when these beliefs are not taken into account. Teacher beliefs are especially important to policy makers, as teachers are the ultimate implementers of educational policy (Pajares, 1992; Ensor, 1998). When teachers consider policies compatible with their beliefs, they may feel more positively about their work and take ownership of the change. Also, it is important to include student teachers in studies of mathematics teachers’ beliefs and conceptions about mathematics and teaching and learning of mathematics as they are the prospective teachers. However, a search of literature in mathematics education revealed no single study on these beliefs involving both student teachers and practising teachers. Thus, a study to explore the perceptions of student teachers
and practising teachers might illuminate the rationale for the existence of differences between beliefs and practices.

As the researcher is a teacher educator from Sri Lanka, it is important for him to link this study to the mathematical situation in his own country. Mathematics is an important subject in the school curriculum of the Sri Lankan education system. It has also received special emphasis throughout the Sri Lankan primary school curriculum. During the past few decades, the developments that have taken place in the primary mathematics curriculum and the innovative steps taken to improve the quality of education are many. However, there are only a few studies in this field and these have revealed low achievement in mathematics amongst pupils throughout the cycle (Kariyawasam, 1991; Ekanayake & Sedre, 1989, Kariyawasam & Wanasinghe, 1982).

Because of the above research studies, low performance in mathematics is evident not only at the primary level, but also at higher levels. Every year after the General Certificate Education (Ordinary Level) Examination (G.C.E. O/L Exam.), nearly 80% of the children drop out from school education after the results are issued (Reform proposal, 1997). This is because of the failure in mathematics. As mathematics is one of the compulsory subjects in G.C.E. (O/L) curriculum, a pass in mathematics is essential to get through the G.C.E. (O/L) Examination. This examination plays a major role in the existing system. The admissions to Year 12 classes, which lead to higher education, the admission to technical colleges, and admission to other educational institutions to follow professional courses and other courses, are based on the results of this examination. However, it is notable that quite a large number of students get zero mark in this examination for mathematics, and among all subjects, the performance in mathematics is the most unsatisfactory one. The reports published by the Department of Education in Sri Lanka indicate that this is due to 'the ignorance of the majority of teachers that mathematics is a discipline in
which formation of concepts takes place, based on concepts formed at an earlier stage' (Department of Examination, 1996, p.4).

Both parents and teachers take the Year 5 Scholarship Examination held for selection purposes of pupils completing the primary cycle, seriously. This examination is wrongly exerting an undesirable influence on the teaching and learning of not only mathematics but on the other subjects in the curriculum at the upper primary level in a number of ways. 'Teaching to the test' by coaching children to produce correct answers to standard on known types of mathematics items despite a lack of basic understanding of concepts seemed to be a common teaching strategy prevalent at the upper primary level. Such strategies, which are often teacher dominated, emphasise drill with most attention being given to number facts and to arithmetic algorithm (Nanayakkara, 1994).

Consequently, Sri Lankan mathematics education needs radical reform. As the researcher of this study is a teacher educator in Sri Lanka, experience gained in this study and the findings might help the researcher to make recommendations about how to carry out a systematic study for the improvement in Sri Lankan situation at district level. It is also the duty of an academic to present his suggestions through his research findings on the existing system of educational practice.

This study could have been carried out in Sri Lanka with data collected from Sri Lankan student teachers and practicing teachers. However, it was not possible for the researcher to conduct this study in Sri Lanka as the situation at the time of data collection was not conducive to collect data because of the ethnic conflict in Sri Lanka.

Although the belief system of teachers of Australian teachers may be different from that of the Sri Lankan teachers, the methodology used in this study will help the researcher to replicate a similar study to explore the perceptions of Sri
1.2 Purpose, Aims & Research Questions

1.2.1 Purpose
The purpose of this study has been to explore the perceptions of teacher trainees and practising primary teachers in relation to the nature of mathematics and the teaching and learning of mathematics in primary schools in New South Wales.

The lessons learnt from this study will have the potential to inform the stakeholders of primary mathematics education about the educational policy context in NSW regarding the teaching and learning of primary mathematics. It is also expected that these lessons might contribute to:

- the improvement of job performance of teachers,
- the improvement of teacher education programs,
- the improvement in mathematics learning for students,
- the enjoyment of mathematics for children and teachers.

1.2.2 Aims
This study aimed to:
- explore the perceptions of teacher trainees and practising teachers; and
- illuminate the rationale for the existence of any differences between beliefs and practices regarding the teaching and learning of primary mathematics.

In view of these aims, the research questions described in Section 1.2.3 were considered.
1.2.3 Research questions

1 What are the beliefs of student teachers and teachers about the nature of mathematics and the teaching and learning of mathematics, and their own classroom practices?

2 How are these beliefs expressed at various stages of the preservice teacher education course and in teaching?

3 What are beliefs about the influences and constraints on classroom practice among the practising teachers?

1.3 The Significance of the Study

1.3.1 Contribution to the reconceptualisation of teacher education programs

The investigation of teachers' beliefs about mathematics, mathematics learning and mathematics teaching, and the influence of those beliefs on teachers' instructional practice is a relatively recent area of research (McLeod, 1992; Thompson, 1992). It is generally agreed that such beliefs are critical factors determining how teachers teach (Thompson, 1984; Pajares, 1992; van Zoest, Jones & Thornton, 1994).

Many factors influence teachers' beliefs and practices. According to Anderson (1998), teachers' actual beliefs, their knowledge and interpretation of advice about teaching, their use and understanding of curriculum documents, and their own experiences as learners of mathematics and their experiences in classrooms are all factors which influence their espoused beliefs and practices. However, mismatches between theories and practices have been reported in the literature (Cooney, 1985; Thompson, 1984, 1992; Lerman, 1990). The precise
link between what teachers say (espoused beliefs) and what they do (enacted beliefs) is not clear (Sosniak, Ethington & Verelas, 1991; Thompson, 1992). A study carried out by Cambourne (1991) to explore the relationship between teachers’ beliefs and practices in the field of literacy has shown that the teachers who went through the process of making their beliefs explicit claimed to feel more confident and empowered as teacher. In addition, the teachers who felt confident and empowered showed a high level of congruency between their ideology, theoretical understandings, and practice. These findings indicate that the teachers’ beliefs must be addressed to achieve significant and prolonged change in the teachers’ practice.

However, it has been reported that most of these training courses develop negative attitudes in students towards mathematics (Billstein & Lott, 1991; Sachs, 1991). Southwell and Khamis (1995) have cited a study that was carried out with 510 primary and secondary students and primary teachers in NSW, where it was found that most believed that the memorisation of facts and procedures was the best way to learn mathematics.

As teacher perceptions, the educational policy context and teacher education are interrelated, this study to explore the perceptions of teacher trainees and practising teachers could contribute to the reconceptualisation of teacher education programs in NSW.

1.3.2 Development of teachers’ awareness of belief system

Teaching is described as creating and sustaining the predisposition and the conditions for learning to occur. Further, teaching is much more than the simple technical application of skills, rather it is a very complex activity requiring teachers to act in highly sophisticated and sensitive ways.

Reflective practice engages the teacher in a cycle of thought and action based on professional experience. It portrays the teacher as creative artist/designer
rather than as engineer/technician. If teachers are to develop increasing awareness of the nature of their work so that they can attend to their teaching in ever more productive ways, they need to be constantly seeking to understand better their own teaching. Moreover, as part of coming to understand what it is they do to assist students to learn, it is believed that they must have awareness and understanding of their own learning and beliefs about learning (Baird, 1991).

Accordingly, the results of this study will illuminate and develop teachers' awareness of their own belief system.

1.4 Locus of Study

1.4.1 The Sites

The study was carried out at the University of Wollongong and at four primary schools in NSW of which two are in the Sydney Metropolitan area and the other two are in the Illawarra area.

The University of Wollongong, which in 1982 federated with the former Wollongong Institute of Education, offers a centre of higher learning for the people of the Illawarra and South Coast and, increasingly, for large numbers of residents of Sydney, other parts of New South Wales, other states and overseas. The University of Wollongong is at present ‘a thriving international community’ in which over 2000 students from over 70 countries have completed degrees in recent years (Study Solutions, 1997).

Over many years the Faculty of Education of the University of Wollongong has developed a reputation as one of the best Teacher Education Institutions in NSW and its teacher training courses have been ratified by the NSW Department of Education and Training (DET) (Undergraduate Degree Information, 1999). Early
Childhood Education, Physical and Health Education, Primary Education and Secondary Education are the major study areas in the Faculty of Education. The programs in these study areas are designed to produce teachers with sufficient understanding of education theoretically and practically. Student teachers have the opportunity of extensive practise teaching in local schools as well as in China, Fiji, Malaysia or Thailand. The University of Wollongong also exports teacher education materials and interactive multimedia software packages from which the teachers around the world have benefited.

Among the four primary schools under study, the first site was a public primary school in the Sydney Metropolitan area. The school was established in 1891 and situated in a socio-economically disadvantaged area. It was populated by approximately 500 students and was a part of the Disadvantaged Schools Program (DSP). Ninety-five percent of the students were from 43 diverse language and cultural backgrounds including Turkish (17%), Arabic (16%), Chinese (15%) and Tagalog (7%). Due to disruption in their own country, that was the first school experience for many post kindergarten age students. The school had to assist its students to overcome disadvantage due to refugee trauma, lack of early schooling, family disruption and high mobility. The school was continuing to implement effective teaching and learning programs focusing on literacy and numeracy. All students were provided with opportunities to develop skills with computer-based technologies.

The second site was a public primary school in the Illawarra area. The school was also a part of the Disadvantaged School Program and had 350 students. The population was multicultural with 60% from English-speaking background. The school was serving a medium density residential area made up of both privately owned and public housing. Most children lived within walking distance of the school. The school was community oriented and has established strong links with its local community. Significant support was obtained from local businesses and service groups. The school had a strong commitment by staff to their own
professional development to ensure that well-researched and quality teaching practice could be provided leading to quality learning for their students. Priorities and targets of the school included a focus on literacy and numeracy development programs to improve student literacy levels and achievement in numeracy. The school had also initiated a program for assisting Aboriginal students, together with their parents.

The third site was an independent private primary school in the Sydney Metropolitan area. The school was run by an independent board and assisted with curriculum support. Total population of students was nearly 150 out of which 60% were from non-English speaking background, predominantly Spanish (14%), Asian Chinese (12%), Arabic (10%) and Turkish (8%). The school was conducting a program called ‘Home and School Association’ to involve parents in school activities. Inservicing for teachers was offered inside and outside the school.

The fourth site was a Catholic primary school in the Illawarra area. The school was run by the Catholic Education Office. However, the school was using the syllabus and curriculum documents supplied by the NSW Board of Studies. Although the population was made up of different languages and cultures, in the past, the predominant culture was Italian. However, the percentage of Italian had decreased from 40% to 5%. At present, nearly 90% of the children are English-speaking. The school was running programs for parents. Many of them benefited from the ‘Parent Reading Programs’. The school had a good reputation among the school community.

1.4.2 Participants
A total of 361 survey responses were received from the teacher trainees in 1st year, 2nd year, 3rd year and 4th year of study from Wollongong University. Among these participants, three from each year level of study were interviewed. A total
of 34 participant practising teachers from four schools responded to the survey questionnaires, and three from each school were interviewed.

Twelve student teachers were selected for interview on a voluntary basis. From the practising teachers who responded to the survey questionnaires twelve were selected for interview as a purposive sample.

The above descriptions provide only an introduction to the sites and participants in the study. The Methodology Chapter will further elaborate on their background, ideas and experiences.

1.5 Structure of the Study

The present report of the study on perceptions of student teachers and practising teachers is structured into a further five chapters with supporting appendices and a list of references.

This introductory chapter has attempted to set out a basis for the study that follows. It has made explicit the rationale for this study with concern to the educational policy context in NSW regarding the teaching and learning of primary mathematics. It has also indicated the significance of the study, which would have effects on future teaching of the participants and influence on the education system of the researcher’s own country.

Chapter 2 provides an understanding of the literature relevant to the study. The literature review presents a developmental account of teachers’ beliefs about mathematics, mathematics teaching and mathematics learning. It also encompasses the literature on the need for mathematics teacher change and provides curriculum development models that have been proposed in the literature. Finally, the literature review chapter provides a basis for interpreting the results of the research and drawing conclusions.
Chapter 3 explains the methodological basis for the research. It also describes the mode of inquiry, which involves the naturalistic paradigm, and the processes of data collection and analysis.

The analysis of the data is presented in Chapters 4 and 5. Chapter 4 deals with the quantitative data obtained from the survey questionnaires. Chapter 5 analyses the qualitative data obtained through semi-structured interviews.

Chapter 6 presents a discussion of the findings from the analyses of the questionnaire data and interview data. It also attempts to relate these findings to relevant mathematics education policy and curriculum in NSW and the related literature. These findings are then used to provide detailed answer to the related specific research questions. The chapter concludes with recommendations for further research specifying the limitations of the present study.
2.1 Introduction

The purpose of this chapter is to draw upon the relevant and available literature to illuminate the theories and important research in connection with this study. Accordingly, the literature will present the current theories relating to the teaching and learning of mathematics and also will review the findings of related studies that have preceded this study in a different context.

As in education, it is common to have alternative theories in mathematics which may have aspects of contrasting nature. Thus, it is important to make explicit the theory or theories of teaching and learning of mathematics with which the researcher approaches a study on mathematics teachers' beliefs. Accordingly, the theories of the research literature are discussed below under the section 'Theories of Teaching and Learning'.

Garofalo (1989) notes that how people study and perform mathematics is influenced by the beliefs about mathematics, and by one's ability to do mathematics. As suggested by Schoenfeld (1985), one's world view of mathematics includes personal beliefs that influence the context in which mathematics is done. It is reported that one way of examining teachers' beliefs about mathematics is to categorise them into those related to the nature of
mathematics, and the teaching and learning of mathematics (Tracey, Perry, & Howard, 1998). Further, recent studies (Kagan, 1992; Pajares, 1992) suggest that teachers’ beliefs about the nature of mathematics and the teaching and learning of mathematics are influenced in significant ways by their experiences with mathematics and schooling long before they enter the formal world of mathematics education, and these beliefs seldom change without significant intervention. Thus, reform in mathematics education becomes ineffective unless the teachers’ beliefs are addressed to achieve significant and prolonged change in the teachers’ practice. Thus, in view of these perspectives, the ideas, opinions and findings that abound in literature review are discussed under the sections ‘The Nature of Mathematics and Teachers’ Beliefs about Mathematics, Mathematics Teaching and Mathematics Learning’ and ‘Teacher Change’ in the following pages.

2.2 Theories of Teaching and Learning

There are various theories that suggest the most effective ways to teach and learn mathematics. Cambourne (1998, cited in Owen, 1998) made a general categorisation of these various theories into two main classifications as ‘Habit Formation Theories’ and ‘Holistic Learning Theories’. However, Ernest (1989) took the view that the theories of learning could be categorised into four models, which were labeled ‘Compliant Behaviour and Mastery’, ‘Reception of Knowledge’, ‘Active Construction of Understanding’ and ‘Exploration and Autonomous Pursuits of Own Interests’. The models ‘Compliant Behaviour and Mastery’ and ‘Reception of Knowledge’ suggest teaching to be a transmission of knowledge, and fit into the ‘Habit Formation Theories’. The other two models ‘Active Construction of Understanding’ and ‘Exploration and Autonomous Pursuits of Own Interests’ belong to the ‘Holistic Learning Theories’.

Similarly, Cambourne’s (1988; cited in Owen, 1998) ‘Habit Formation’ theories are also known as ‘Behaviourist’, ‘Mechanist’ or ‘Absorption’ theories whereas
the 'Holistic Learning' theories mean the 'Cognitive', 'Gestalt', 'Constructivist' or 'Meaningful' theories.

2.2.1 Behaviourist Theories of Teaching and Learning: An Overview

The 'Habit Formation' or 'Behaviourist' theories of teaching and learning have dominated mathematics education over the last century until the 1980’s (Battista, 1994). The behaviourist school of psychologists, mainly with animals, has extensively studied habit learning. The chief proponents of this kind of learning were the famous educators and researchers such as Thorndike, Skinner, Pavlov and Gagne.

In the experiments carried out by the behaviourists, a stimulus-response bond was made stronger by repetition and this reinforced the association between them. Gradually, it resulted in a habit formation. 'In this kind of learning, certain actions are reinforced as a result of their outcomes, so learning follows action. And what is learnt is action: the cognitive element is small' (Skemp, 1989, p.82).

Drill and practice and rote learning are the consequences of these theories very much used in mathematics education. Step by step instruction with regular reinforcement is recommended as the common teacher pedagogy, as the behaviourists' general interpretation of instruction is that activities should be created which solidify the bonds between stimuli and responses.

Memory is an integral part of behaviourism. Automatisation and time-per-task outcomes are considered to be very important. The teacher assumes a dominant role by accepting responsibility for student progress and must be able to make instructional changes when indicated. Generalisation is developed through demonstration of the skill under varied circumstances. Consequently,
programmed learning models were popular amongst mathematics educators and researchers in 1960s and 1970s (Leder & Forgasz, 1992).

Transmission or absorption is the base for traditional mathematics and instruction and curricula. According to this view, mathematical structures invented by others and recorded in texts or known by authoritative adults are passively "absorbed" by students. Also teaching is said to involve transmitting sets of established facts, skills and concepts to students (Clements & Battista, 1990). However, 'Habit Formation' theories had to face many criticisms even during the middle part of this century, as it was believed that the learners were unable to generalise their learning to solving problems of a similar nature. In addition, Wertheimer's findings questioned the effectiveness of drill and practice for learners of mathematics (Leder & Forgasz, 1992).

The reform movement of the National Council of Teachers of Mathematics (NCTM) in the USA released its 'Curriculum and Evaluation Standards for School Mathematics' in 1989 and called for giving up curricula that promoted thinking about:

- mathematics as a rigid system of externally dictated rules governed by standards of accuracy, speed, memory ... A mathematics curriculum that emphasises computation and rules is like a writing curriculum that emphasises grammar and spelling; both put the cart before the horse ... There is no place in a proper curriculum for mindless mimicry mathematics (p.44).

This call from NCTM was strongly supported by Battista (1994), Carpenter (1989), Skemp (1971) and several others with the agreement that understanding plays no part in habit formation learning theories, where Battista (1994) contends that

By reducing mathematics to the following of set procedures, these teachers were inadvertently robbing their students' of opportunities to "do" mathematics. Because students' intuitive ideas about making sense of mathematics were ignored, and therefore devalued, the development of their mathematical reasoning skills was impeded... (p.467).
2.2.2 Constructivist and Current Theories of Learning

The Habit Formation Theory or the transmission model for instruction which means that the 'knowledge can be transferred intact from the mind of the teacher to the mind of the learner' (Bodner, 1986, p.874), declined in popularity in the 1990s and the 'Holistic and Constructivist Theories' of learning remained the most pervasive epistemology in mathematics education (Battista, 1994; Stein et al., 1996). Since then, constructivist theory has been prominent in recent research on mathematics learning and has provided a basis for recent mathematics education reform efforts (Steffe & Gale, 1995).

The term constructivism serves as an umbrella term for a wide diversity of views, which use the second question as their starting point. There are similarities and differences across the many theories claiming some kinship to constructivism. However, they are of the general view that (1) learning is an active process of constructing rather than acquiring knowledge, and (2) instruction is a process of supporting that construction rather than communicating knowledge (Duffy & Cunningham, 1996).

While elaborating on these two general views of constructivism, Noddings (1990) notes some of the basic concepts on which constructivists generally agree. These concepts could be tabulated as:

- All knowledge is constructed where mathematics knowledge construction involves reflective abstraction at least in part
- Cognitive structures that are activated in the processes of construction account for these constructions
- Transformation of existing cognitive structures are under continual development and induced by purposeful activity
- Methods of teaching must be in accord with cognitive constructivism.
Koehler and Grouws (1992) assert a similar view more specifically paying attention on teaching behaviour as:

In the constructivist approach, teaching behaviour is examined from the viewpoint of how much it encourages or facilitates learner construction of knowledge. Teaching is viewed on a continuum between negotiation and imposition, and the teacher's role is to find and adjust activities for students. Social interactions are seen as a critical part of knowledge construction ... (p.12)

Tytler et al. (1999) support these views of pedagogical constructivism by discussing Shulman's theory of knowledge and the implications for teacher training of constructivist views (see Section 2.3.2).

As constructivism suggests that knowledge is not objective and that it must be seen as a personal construct of the learner, learners are not passive recipients of the facts but active developers of their own networks of concepts and theories (Holt-Reynolds, 2000). They build up their own understandings by making their own meanings. In fact, the constructivists focus their activities so as to engage the student in ways that lead the student to construct meanings (Cobb, 1994). They generally push for deeper understandings and meanings where the students are free to ask questions, to offer alternative solutions, and to interact with variety of materials.

Research from cognitive science and mathematics education is producing a growing body of evidence that supports the constructivist view of learning as the process of making meaning from the materials of an individual mind's experience (Duffy & Cunningham, 1996). According to constructivism, it is also recognised that students actively build their own mathematical knowledge from their experiences and rely on their peers, tutors, and themselves for feedback.
Likewise, Confrey (1990, p.110) proposes that teachers, as constructivists, do not teach students about the mathematical structures which underlie objects in the world; but teach them 'how to develop their cognition', 'how to see the world through a set of qualitative lenses' which they believe provide a powerful way of making sense of the world, 'how to reflect on those lenses to create more and more powerful lenses' and 'how to appreciate the role these lenses play in the development of their culture'.

Hiebert et al. (1996) take the view that engaging students with problems, dilemmas and questions is the first thing to do as a beginning of curriculum and instruction. This will allow the students to reflect upon phenomena, to seek information, to search for solutions and to resolve incongruities. Consequently, this view of mathematics learning as problem solving is also a basis for constructivist perspectives. Davenport and Howe (1999) examined the effectiveness of teaching programs by presenting contextualised materials to children and allowing them to solve problems collaboratively in groups. Children were then asked to explain these problems in pairs to guide each other. Using the language of problem solving was found to enhance their understanding. They concluded that contextualised mathematics is more effective through verbal explanation. In another study, by Albert and Anton (2000), understanding was valued as important in problem solving. The use of journal entries to record children’s understanding of real-life problems was taken as the basis of the study. Children were first asked to write journal entries while solving problems collaboratively in groups. This allowed the children to experience different strategies in solving one single problem, and communicate their understanding through writing. This process also helped the teacher to reflect on the understanding of the mathematical concept explored.

Anderson (1996) claims that child-centredness comes from constructivist theory where 'students are actively involved with mathematics through "constructing" their own meaning as they are confronted with learning experiences which build
on and challenge existing knowledge' (p.31). Strommen (1996) supports this idea when he purports that the focus of constructivism is the child as a self-governed creator of knowledge.

The constructivists view learning as an activity in context. This view leads to the need to examine and understand the situation as a whole. Rather than seeing the activity as a vehicle for moving information into our head or the content domain as central with activity and the rest of the context serving a supporting role, the entire gestalt must be integrated with what is learned.

Further, the immersion of the learner in a natural context or cultural context where the learner engages in the mathematical experiences is also proposed (Bluemenfeld et al., 1994; Tate, 1994; Yackel et al., 1990) as a principle of the constructivist learning process. The context provides a bridge between the children's informal mathematical knowledge and abstract mathematical concepts (Burnett, 1993; cited in Malone & Ireland, 1996). As Tate (1994) pointed out, an appropriate cultural context allows the connection of understandings and experiences in a far more profound way than using a de-contextualised process. In fact, in the study by Nuthall and Patrick (1993; cited in Malone & Ireland, 1996), it was shown that children's public and private experiences and the sociocultural context of the classroom had a profound effect on the way the curriculum was translated into the child's personal beliefs and knowledge.

Burnett (1993; cited in Malone & Ireland, 1996) aimed to develop children's mathematical concepts by using language as the bridge. Language plays a major role in the constructivist view of learning, and develops positive attitudes among learners as they develop skills to discuss, read, draw and reflect in everyday terms (Bickmore-Brand, 1990). Boomer (1986; cited in Owen, 1998, p.23) adds to this view by suggesting that ‘the more of their own language that the learners can use with the new idea, the more ways they can relate the new information to their own experience and the more likely they will reach an
understanding'. Thus, the language-intensive atmosphere serves as the catalyst for students to draw upon previous knowledge and experiences and make connections with the new experience. Further, understanding decontextualised situations also becomes possible if the learners have been immersed in advance in a context which is interesting, relevant and meaningful (Bickmore-Brand, 1990). As Stein et al. (1996) suggest, intellectual risk taking by which learners have opportunities to explore the mathematics and trial ideas in a supportive environment, is an integral part of the holistic learning process. Thus, the contributions of the students are integral in the holistic learning process.

As constructivist theory claims that learners actively construct their own meaning and understanding by interacting with their surroundings, in order to interact and construct their own knowledge, pupils need to be active – not passive – in the learning process, hence the need for the lessons to be hands-on, with active pupil participation. This approach also acknowledges that pupils bring to their learning pre-conceived ideas and knowledge that relate to prior experience. A role of the teacher is thus to challenge these ideas so that pupils develop viable scientific understandings. A constructivist teacher will provide a supportive atmosphere for learning where social interaction is supported as well as intellectual development. A constructivist teacher will also listen to, encourage and value pupils’ ideas.

In a similar approach to Davenport and Howe (1999) and Albert and Antos (2000) who used language as a way of enhancing problem-solving, so Burnett used language to develop children’s mathematical concepts. The study was conducted by implementing instructional games into a classroom of children in their first year of formal schooling. 'The success of the study was attributed to the discussion that stems from the games, the ability of the teacher to individualise instruction, and the social context in which the games were played' (p.123).
Writing had been accepted as an effective form of discourse for learning mathematics by many researchers before Albert and Antos (2000) carried out their study (Anderson, 1996; Miller, 1993; Wilde, 1991). For example, a learning journal provides an effective framework for student’s writing and learning. Students make use of these journals to express and clarify their thoughts while the teachers are also benefited, increasing their understandings of how the student thinks (Miller, 1993). Also, the student's journal provides feedback on the effectiveness of teaching.

Australian reporting on constructivist research in mathematics education dates from around the mid-1980s as ‘the term constructivism does not appear anywhere in the proceedings of the 5th International Congress on Mathematical Education (ICME 5) held in Adelaide, Australia in 1984’ (Malone & Ireland, 1996). However, constructivism remains the most pervasive epistemology in mathematics education in the 1990s. According to constructivist theories, ‘capacity to engage in the processes of mathematical thinking, solving problems, conjecturing, examining, making inferences from data, abstracting, exploring, inventing and justifying’ (Stein et al, 1996) – all contribute to the complete understanding in the mathematics education field. As Lowery (2002) stressed in relation to preservice teacher education:

Studies that examine factors affecting the construction of teachers’ knowledge, teacher learning, and context can make significant contributions in strengthening the profession of preparation of teachers and complement a growing knowledge base for teaching (p.70).

The above analysis of constructivist approaches to mathematics learning can be summarised through Davis, Maher and Noddings (1990): ‘learning mathematics requires construction, not passive reception, and to know mathematics requires constructive work with mathematical objects in a mathematical community’ (p.2).
Hence, it is the responsibility of mathematics teachers to establish a constructivist mathematical environment in their classroom.

To summarise, all the theories about teaching and learning of mathematics could be categorised into two main classifications as the ‘Habit Formation Theories’ and the Holistic Learning Theories. The Habit Formation Theories of learning dominated mathematics education until 1980s (Battista, 1994) which involved forming strong association between a stimulus and a response, through continued practice. However, there were many criticisms about the Habit Formation theories mainly because of the argument among the many current theorists that they did not emphasise ‘understanding’ as an essential component of learning. On the other hand, the Holistic Learning Theories or the constructivist and current theories of learning mathematics require students and teachers to view mathematics as a dynamic process where knowledge is constructed, not passively received, through context rich, language intensive and relevant experiences.

2.3 The Nature of Mathematics and Teachers’ Beliefs about Mathematics, Mathematics Teaching, and Mathematics Learning

One’s conceptions of mathematics influence the teaching and learning of mathematics. The ways of presenting mathematics is mainly dependent on the beliefs one holds about the nature of mathematics (Hersh, 1986; Thom, 1973; Thompson, 1992). ‘Perceptions of the nature of and role of mathematics held by our society’ have a major influence not only on mathematics instruction but also on the development of school mathematics curriculum and research (Dossey, 1992, p.39).
It is important to address some important issues about the nature of mathematics prior to finding means and ways to formulate good mathematics teaching. Mathematics is seen as both a static discipline and a dynamic discipline. Those who see mathematics as a static discipline define it as a discipline with a known set of concepts, principles and skills. For many others, mathematics is a dynamic, growing field of study (National Council of Teachers of Mathematics, 1989; National Research Council, 1989). It is constantly changing as a result of new discoveries from experimentation and application (Crosswhite et al, 1986; cited in Dossey, 1992, p.39). Because of these contrasting views of the nature of mathematics, the conceptions of mathematics fall along a continuum since the age of the Greeks. These conceptions range from axiomatic structures to generalised heuristics for solving problems.

2.3.1 An Overview of the Conceptions of Mathematics about the Nature of Mathematics

Historically, Plato and his student Aristotle were considered to be the first major contributors in the discussions of the nature of mathematics. Plato discussed mathematics as 'an abstract mental activity on externally existing objects that have only representations in the sensual world' (Plato, 1952; cited in Dossey, 1992, p.40).

On the contrary, his student, Aristotle, held a different view. Unlike Plato’s view of mathematics as based on a theory of external, independent, unobservable body of knowledge, Aristotle’s view was based on ‘experienced reality where knowledge is obtained from experimentation, observation and abstraction’ (Dossey, 1992,p.40).
Furthermore, according to Aristotle, knowledge could be divided into three genera: the physical, the mathematical and the theological. Mathematics was considered to be the one 'which shows up quality with respect to forms and local motions, seeking figure, number, and magnitude, and also place, time, and similar things' (Ptolemy, 1952; cited in Dossey, 1992, p.40). In addition, Aristotle viewed the construction of a mathematical idea to come through idealisations performed by the mathematician as a result of experience with objects. Thus, two of the major contrasting themes concerning the nature of mathematics were from Plato and his student, Aristotle and dated back to the fourth century BC.

By the middle ages, different conceptions on the nature of mathematics were proposed by a number of mathematicians including Francis Bacon, Jean D'Alembert and other members of the French salon circle, Descartes and Immanuel Kant (Dossey, 1992). Late in the 19th and early 20th century, there were three major schools of thought, namely, logicism, intuitionism, and formalism. However, all these three schools of thought tended to view the contents of mathematics as products. Though they too contributed in the discussion of the nature of mathematics, they were unable to find a widely acceptable basis for the nature of mathematics (Dossey, 1992).

Modern views of the nature of mathematics in the late 1970s and the 1980s focus on an interest in the philosophy of mathematics and its relation to learning and teaching. According to Sowder (1989, cited in Dossey, 1992), there were at least five conceptions of mathematics that can be identified in the mathematics education literature. These conceptions were found to fall along an externally-internally developed continuum, where two of them based on the external (Platonic) view of mathematics and the remaining three based on internal (Aristotelian) view.

The view that 'mathematics is a discipline characterised by accurate results and infallible procedures whose basic elements are arithmetic operations, algebraic
procedures, and geometric terms and theorems' emphasises knowing mathematics as 'equivalent to being skilful in performing procedures and being able to identify the basic concepts of the discipline' (Thompson, 1992, p.127). It is commented that this conception of mathematics 'can lead to instruction that places undue emphasis on the manipulation of symbols whose meanings are rarely addressed, as documented in the research literature' (p.127).

According to the alternative view of the meaning and nature of mathematics, mathematics is a mental activity involving 'conjectures, proofs and refutations, whose results are subject to revolutionary change and whose validity, therefore, must be judged in relation to a social and cultural setting' (Thompson, 1992, p.127).

According to this view, knowing mathematics is making mathematics, which is characterised by creative activities or generative processes (Hersh, 1986). The same view was held by several prominent mathematicians (Halmos, 1975; Polya, 1963; Steen, 1978; Thom, 1973; cited in Thompson, 1992, p.128). A similar view is reflected in several documents such as 'The Cockroft Report' (Committee of Inquiry into the Teaching of Mathematics in Schools, 1982), the 'Curriculum and evaluation Standards for School Mathematics' (National Council of Teachers of Mathematics (NCTM), 1989), and 'Everybody Counts' (National Research Council, 1989). The conception of mathematics teaching derived from these documents is an activity in which 'students engage in purposeful activities that grow out of problem situations, requiring reasoning and creative thinking, gathering and applying information, discovering, inventing, and communicating ideas, and testing those ideas through critical reflection and argumentation' (Thompson, 1992, p.128).

From these views and studies about mathematics teaching, it is observed that how teachers interpret and implement curricula is influenced by their knowledge
2.3.2 Teachers’ Beliefs about Mathematics, Mathematics Learning and Mathematics Teaching

All teachers of mathematics hold beliefs about mathematics, mathematics learning and mathematics teaching. These beliefs influence and guide teachers in their approaches to teaching mathematics (Baroody, 1987). The investigation of teachers' beliefs about mathematics, mathematics learning and mathematics teaching, and the influence of those beliefs on teachers' instructional practice is a relatively recent area of research (McLeod, 1992; Thompson, 1992). It is generally agreed that such beliefs are critical factors determining how teachers teach (Pajares, 1992; Thompson, 1984; van Zoest, Jones & Thornton, 1994).

There are different models on the beliefs about the nature of mathematics and the teaching and learning of mathematics. Ernest model (1989) about the beliefs on the nature of mathematics identified three different conceptions of mathematics:

- a dynamic problem-driven view of mathematics which considers mathematics as continually expanding field of human creation and invention
- a static unified body of knowledge bound by logic and reasoning
- a bag of tools to indicate that mathematics is an accumulation of fact, rules and skills.

Shulman (1986, 1987) speaks of seven facets that make up a teacher's knowledge base:
...content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical reasoning, knowledge about learners, knowledge about educational contexts, and knowledge about educational purposes and values. The informed application of this knowledge base leads to effective teaching practice (1987, p.8).

Shulman’s notion of teacher knowledge was further developed and discussed in many forums and the role of a mathematics teacher is emphasized as important in helping students ‘to develop effective knowledge structures, representations of mathematical content that will allow the students to productively explore a suitable range of mathematical problems’ (Chinnappan & Lawson, 1999, p.167).

Two of Shulman’s categories relate specifically to subject matter: content knowledge, and pedagogical knowledge (cited in Tytler et al. 1999, p.195). Content knowledge includes:

- knowledge of concepts and facts;
- knowledge of the substantive structure of a subject, or the way concepts interrelate; and
- knowledge of the syntactical structure of the subject, or the operating rules relating to how knowledge is generated and validated in the subject.

Pedagogical content knowledge refers to the way knowledge can be organized and transformed to be effectively learnt, including selection of materials for instruction. This includes:

- knowledge of instructional strategies and representations;
- knowledge of curriculum and curricular materials,
- knowledge of students’ understandings and potential misunderstandings; and
- overarching conception of teaching a subject. (ibid. p.195).

The literature on teaching mathematics generally classifies the beliefs on how to teach mathematics into two main categories. Burton (1993) identified two basic
approaches one of which is a transmission approach in which the knowledge is simply transmitted by teachers while the other approach sees teaching as facilitating learning in which children construct their own mathematical knowledge through the interaction with the physical and social environment.

Similar models were proposed by Perry, Howard and Tracey (1999), and Warren and Nisbet (2000). However, Perry, Howard and Tracey called these categories as transmission and child-centredness while Warren and Nisbet denoted these as traditional view and contemporary view.

As Garofalo (1989, p.502) states, beliefs about the nature of mathematics and mode of mathematics instruction 'are important not only because they influence how one thinks about, approaches and follows through on mathematical tasks but also because they influence how one studies mathematics and how and when one attends to mathematics instruction.' However, mismatches between theories and practices have been reported in the literature (Cooney, 1985; Lerman, 1990; Thompson, 1984, 1992). The precise link between what teachers say (espoused beliefs) and what they do (enacted beliefs) is not clear (Sosniak, Ethington & Varelas, 1991; Thompson, 1992). According to Thompson (1992), the relationship between teachers' conceptions of mathematics and their instructional practice is complex and this complex relationship is influenced by the social context in which mathematics teaching takes place. This social context consists of 'the values, beliefs, and expectations of students, parents, fellow teachers and administrators; the adopted curriculum; the assessment practices; and the values and philosophical leanings of the educational system at large' (p.138).

Teachers' espoused beliefs can often seem to be in internal conflict. Sosniak et al. (1991) found that the teachers can have beliefs about the aims of instruction in mathematics, the role of the teacher, the nature of learning, and the nature of the subject matter, which would be logically incompatible. However, these
espoused beliefs are of great importance as they play a critical role in teachers' instructional practice. Accordingly, the espoused beliefs about mathematics, mathematics learning and mathematics teaching are important and studies should be continued.

Thompson (1992) believes that there is a genuine need for descriptive studies, which actually make explicit a mathematics teacher's perceptions. Brownlee et al. (1998) propose that preservice teacher education students are likely to have acquired naïve beliefs about learning and teaching, that need to be integrated with theoretically informed beliefs, if they are to function effectively in classrooms. Their study has explored the nature of such integration using a sample of Graduate Diploma in Education students engaged in an educational psychology subject, which was designed to help students develop constructivist beliefs and approaches to learning. It seemed likely that both university-based and practice teaching experiences contributed to changes in students' informed conditional knowledge.

In his study of secondary mathematics education with six high school teachers, Owen (1998) found that their beliefs could be placed in a continuum between Habit Formation or traditional thinking and Holistic and current thinking. He also reports that the years at university or teachers college are rarely mentioned, as a considerable influence in the evolution of the teachers' beliefs and practices, and the teachers could generally not explicitly recognise their training as having a significant influence on their beliefs. He further suggests that university courses need to focus further on nurturing the beliefs and practices of beginning teachers. He also recommends that 'it would be worthwhile to focus on beginning teachers and experienced teachers as separate groups and contrast the factors that influence the developments of their pedagogy at the different stages of professional growth' (p.114).
A study carried out by Tracey, Perry and Howard (1998) reported on comparisons concerning the espoused beliefs about mathematics, mathematics learning and mathematics teaching of the secondary teachers in both government and Catholic schools across an urban and rural school regions in NSW. The teacher respondents demonstrated significant differences among the teachers across the regions, types of school and gender. These differences could be summarised as:

- There was a higher level of child-centredness among north coast teachers than those teaching in south western Sydney;
- Catholic school teachers scored higher on child-centredness than government school teachers;
- Female teachers scored significantly higher on child-centredness than male teachers; and
- Male teachers scored significantly higher on transmission than female teachers.

Perry, Howard and Tracey (1999) also report an investigation of teachers' beliefs concerning the nature of mathematics, and the learning and teaching of mathematics, which was carried out with Head Mathematics Teachers in Australian secondary schools. They compared these beliefs with espoused beliefs of classroom mathematics teachers in the same schools. This study has shown that espoused beliefs about mathematics, mathematics learning, and mathematics teaching can be measured and compared across group of teachers.

In this study, very few respondents agreed that “right answers are much more important in mathematics than the ways in which you get them”. As well, nearly three quarters of all teachers believed that “mathematics is the dynamic searching for order and pattern in the learner's environment”, while 80% or more of HMT (Head Mathematics Teachers) and OMT (other mathematics teachers) groups believed that “mathematics is beautiful, creative and useful human
endeavour.” Also, there were high levels of agreement from both groups of teachers on the statements “mathematics knowledge is the result of the learner interpreting and organising the information gained from experiences,” “periods of uncertainty, conflict, confusion, surprise are a significant part of the mathematics learning process,” “mathematics learning is enhanced by activities which build upon and respect students’ experiences,” and “mathematics learning is enhanced by challenge within a supportive environment.”

Further, there were high levels of agreement from both groups of teachers on the statement “teachers should provide instructional activities which result in problematic situations for learners,” “teachers should recognise that what seem like errors and confusions from an adult point of view are students’ expressions of their current understanding,” “teachers should negotiate social norms with the students in order to develop a cooperative learning environment in which students can construct their knowledge,” while the majority of both groups disagreed with “teachers or the textbooks – not the student – are the authorities for what is right or wrong”.

A study carried out with a sample of 387 primary teachers by Warren and Nisbet (2000, p.632) reported on the ongoing development of an instrument to identify and measure factors associated with primary teachers’ purported beliefs about mathematics and teaching and assessing mathematics. It was found that primary teachers held a fairly limited view of what mathematics was. Further, the beliefs that teachers held about teaching in traditional and contemporary environments were not delineated in their responses.

All these studies indicate that teachers hold beliefs about the nature of mathematics and about the teaching and learning of mathematics, and these beliefs contribute to their classroom practice. Thus, whether these beliefs are deeply rooted or not, teacher change becomes an important aspect of implementing any new policy initiatives.
In short, many factors influence the classroom practices of mathematics teachers. Although the relationship between beliefs and practice is complex, studies have demonstrated beliefs about the nature of mathematics and its teaching and learning appear to have a significant effect on their approaches to teaching. Mathematics is described as both a static discipline in which mathematics is seen as a unified body of interrelated structure and a dynamic discipline in which mathematics is seen as an expanding field in which the process of inquiry is central. Thus, the beliefs about mathematics teaching and learning held by teachers of mathematics fall within a continuum ranging from a traditional view of mathematics being taught and learned through the transmission of mathematical skills and knowledge from the teacher to the learner to a current constructivist view of learning where students are actively involved with mathematics, constructing their own meaning.

2.4 Teacher Change

Significant and wholesale changes are necessary to bring mathematics teaching in line with current theory. The National Council of Teachers of Mathematics (NCTM, 1991) "Standards' emphasise mathematics teaching as a dynamic tool for thought, not just as a set of operations to be learned. This emphasis is also reflected when the National Council of Teachers of Mathematics (NCSM, 1989) stipulates the five goals for rethinking mathematics teaching and learning as that students should (1) learn to value mathematics, (2) become confident in their ability to do mathematics, (3) become mathematical problem solvers, (4) learn to communicate mathematically, and (5) learn to reason mathematically. In addition, it is proposed that the students have 'a non-threatening environment in which they are encouraged to ask questions and take risks' and a learning climate to incorporate 'high expectations for all students' irrespective of 'sex, race, handicapping condition, or socioeconomic status' (NCSM, 1989, p.46). The council also advocates that teachers should have less emphasis on 'paper-and-
pencil’ computation, rote memorization of rules and formulas, written practice, ‘one answer, one method’, and teaching by telling. This call for strategic shifts in mathematics instruction for all students places emphasis on understanding mathematics by helping students make sense of what is taught in the class (NCTM, 1989;1991;1995).

These recommendations for this strategic shift in mathematics instruction are grounded in constructivist theory which is often referred to as ‘inquiry oriented’ and stem from a broad research base in mathematics education (Noddings, 1990; Grouws, 1992). This approach to mathematics instruction represents fundamental changes in teaching practices – a shift away from the exclusive use of traditional ways of teaching. However, as Fullan (1993,p.ix) states, ‘teachers’ capacity to deal with change, learn from it, and help students learn from it will be critical’ for this shift to take place. As noted by Chinnappan and Lawson (1992), apart from the control of the knowledge construction process that rests with the student, the teachers’ actions in a lesson also determine the outcome of the process.

The beliefs held by teachers can create large barriers to reform. The prior beliefs and experiences that teachers bring with them to the experience of learning to teach affect what they learn (Ball, 1996; Grant et al., 1996). Several researchers have suggested that learning new theories and concepts are minimally effective in changing preservice teachers’ general beliefs about teaching practices in part because teachers filter what they learn through their existing beliefs. Their beliefs seem to be drawn from previous vivid episodes or events in their lives (Pajares, 1992), particularly their beliefs about teaching and learning derived from their own experiences as students (Holt-Reynolds, 1992).

Teachers with traditional beliefs that are incompatible with those underlying the reform effort also could block the reform effort. They may be resistant to such reforms as have been mentioned in the Professional Standards for Teaching.
Mathematics (NCTM, 1991). According to Battista (1994, p.468), this is because 'the teachers who are asked to teach the reformed mathematics curriculum are products of an old curriculum'. These teachers 'can understand many of the innovations only with great effort' as their beliefs are 'incompatible with those of the new curricula'.

Furthermore, Battista (1994) adds that:

Like most adults, almost all current teachers were educated at the elementary, secondary, and university levels in curricula that promoted the conception of mathematics as procedures rather than as sense-making. Moreover, the school environment in which teachers teach demand this rule-based view of mathematics. Their mathematics textbooks support it. State and district testing programs assess adherence to it. Most parents, school officials and politicians – all of whom dictate curricula to teachers – also see mathematics as sets of rules to follow (p.468).

Further, preservice teachers also seem to be reluctant to break away from the traditional pattern of mathematics teaching even when they are exposed to new techniques and new materials. This was evident in a study carried out by the National Centre for Research on Teacher Education (Schram et al., cited in Pejouhy, 1990). Even though the prospective teachers who had participated in an innovative mathematics class recognised its value for their own mathematical understanding, they were unwilling to commit themselves to transferring these ideas to their teaching. More than half of the students in the study concluded that they would teach a more traditional, arithmetic-dominated curriculum in their own elementary classrooms. As Ball (1988, cited in Pejouhy, 1990) suggests, the preconceptions about how mathematics should be taught hinder the prospective teachers’ own experience with more innovative methods from altering their thinking about teaching mathematics.
A study on teacher change (Mayers, 1994) to determine whether modifications could be induced in primary student-teachers' beliefs about, and attitudes towards, mathematics and mathematics teaching through their participation in a mathematics education course which adopted constructivism as its theoretical framework, showed that students demonstrated a significant shift towards a constructivist perspective. On the other hand, a study by van Zoest, Jones, and Thornton (1994) reported that preservice teachers who were involved in a program designed to engender positive beliefs about a socioconstructivist classroom environment had difficulty translating these beliefs into long term practice.

It has been also found that the beliefs held by teachers about mathematics teaching and the dilemmas generated by practice teaching were related to the lack of knowledge of specific mathematics pedagogical content and their own weak understandings of the mathematics content they have to teach. Brown et al. (1999) are of the view that “mathematics becomes subsumed by the pragmatics of pedagogic concerns (p.312). In a study to explore the understanding of primary student teachers about mathematics and its teaching, Brown et al. aimed to develop a theory of how school mathematics and its teaching were constructed by preservice teachers in the transition from learner of mathematics to teachers. They also documented the cognitive and affective elements of their understandings of mathematics and explored how they moved into the teaching context. This study demonstrated Shulman's notion of the transformation of subject knowledge into pedagogical content knowledge. Brown et al. believe that “pedagogical content knowledge is the most important and difficult element of learning to be an effective teacher” (p.304).

Teachers’ beliefs must be addressed to achieve significant and prolonged change in the teachers’ practice. Cambourne (1991) found that teachers who went through the process of making their beliefs explicit claimed to feel more confident and empowered as teachers. These teachers showed a high level of
congruency between their ideology, theoretical understandings and practice. According to Battista (1994), the failure to address the deeply held beliefs of mathematics teachers seems to be one of the most significant factors that hinder the reform process. Recent research on teaching and teachers has provided evidence that how the mathematics curriculum is implemented depends on teachers’ perceptions and images of mathematics they teach (Cooney, 1994).

There has been growing evidence to suggest that primary teachers often hold negative attitudes towards mathematics (Sullivan, 1987) and that this negativity may be reflected in the poor teaching of this curriculum area (DEET, 1989). It is also found that an alarming proportion of preservice primary teachers lack the content knowledge to teach effectively mathematics (DEET, 1989).

Further, as Boomer (1986) claims, if the teachers have not articulated the beliefs that drive their practice, their capacity to change radically will be reduced.

Recently, research on teachers’ beliefs about mathematics has grown considerably and taken many directions. Thompson (1992) indicated there should be more consideration to closely examine links between conceptions of mathematics and instructional practice. Consistencies between beliefs and classroom actions have been described by some researchers (Kaplan, 1991; Peterson, Fennema, Carpenter & Loef, 1989) while inconsistencies have also been identified (Brown, 1986; Cooney, 1985; Shaw, 1990; Thompson, 1984).

In short, the relationship between the beliefs and practices of mathematics teachers have been often discussed in research. Teachers’ beliefs about mathematics, and its learning and teaching are known to affect the students’ learning. However, teachers who had strongly held beliefs about mathematics and its teaching and learning did not always reflect these beliefs in their practice. Thus, the relationship between the beliefs and practices of mathematics teachers have been shown to be complex. It can be observed that schools often seem to
be involved in the implementation of new policies and educational directions. However, studies have shown that the teachers' beliefs must be addressed to achieve significant and prolonged change in the teachers' practice.

It has been found that the prospective primary teachers have been neglected and overlooked in prior research studies about their beliefs. However, it is important to explore their beliefs and to compare their beliefs with those of the practicing teachers to see where these beliefs come from. This study will have the potential to address such an issue.

2.5 Conclusion

The review of related literature presented in this study has provided a theoretical framework for the requirements of this inquiry. It has also provided findings that occurred prior to this study and a developmental account of the theoretical considerations relevant to this study. The methodological basis for this study is discussed in the next chapter with reference to the mode of inquiry.
3.1 Introduction

In a discussion of the nature of research, Mouly (1978) notes three means of searching for truth: experience, reasoning and research. It is also stated that 'these three categories are complementary and overlapping', and 'most research problems call for the operation of varying degrees of all three' (Mouly, 1978, p.14).

Burns (2000, p.1) defines research, in general terms, as 'a systematic investigation to find answers to a problem'. Also, 'research is seeking through the methodological processes to add to one's own body of knowledge and, hopefully, to that of others' (Howard and Sharp, 1983 cited in Bell, 1987, p.2).

The “problem” for which this study aims “to find answers” and therefore “to add to one's own body of knowledge”, is to inquire into the perceptions of teacher trainees and practising primary teachers in relation to the nature of mathematics in primary schools in New South Wales.

This study was based on systematic investigation and methodological processes. It started with a problem of the perceptions of teachers and student teachers about the nature of mathematics and the teaching and learning of mathematics which arose from experience and then proceeded with the following: identifying
the issues through researching the literature, deciding on the methodological design of the study, selecting instruments for data collection, collecting data, analysing the data and then drawing conclusions from the findings.

This research process was strengthened by drawing on the researcher's personal experience as a teacher for more than ten years and as a teacher educator for "Mathematics Teaching Methodology" in his university. Clearly, it also draws on Mouly's third exploratory means of searching for truth as reasoning is brought to bear on each element of the research and the relationships between them.

The purpose of this chapter is to provide a detailed description of the paradigm, concepts and techniques for conducting this particular research study.

The first section discusses the choice of a 'naturalistic paradigm' for this inquiry. After this, a rationale and definitions of key paradigmatic structures are discussed.

The second section describes the choice of the research design in conjunction with the naturalistic paradigm, examining its strengths and weaknesses. Further, in view of the explorative nature of the study, a model in which quantitative and qualitative methods are integrated is discussed here. In addition, the methodological basis for the research provides justification for the selected research design.

The third section presents the context of the study describing the site and participants. Size of the sample and method of selection are also discussed here.

The processes of data collection and data analysis are covered in the fourth and fifth sections respectively. Finally, the sixth section addresses reliability and validity issues in the research.
3.2 Rationale for using the naturalistic paradigm

A paradigm is defined as 'a world view, a general perspective, a way of breaking down the complexity of the real world' (Patton, 1978, cited in Lincoln & Guba, 1985, p.15). There are a number of different ways we try to "break down the complexity of the real world" to perceive the world in which we live. The contrasting perspectives of the way we perceive social reality are well documented in the literature (Cohen, Manion & Morrison, 2000; Lincoln & Guba, 1985, Robson, 1993). Two of these views are:

1. The objectivist or positivist approach to the social world. This approach treats 'the world of natural phenomena as being external to the individual' (Cohen & Manion, 1989, p.38) – a paradigm leading to scientific and experimental research.

and

2. The subjectivist or Naturalistic approach to the social world. This approach views 'the social world as being of a more personal and human-created kind' (Cohen & Manion, 1989, p.38) – a paradigm, which leads to more descriptive and interpretive research, characterised by a concern for the individual.

Of the two paradigms - quantitative and qualitative – the quantitative paradigm is referred to as the dominant paradigm by some authors because the purpose, procedures, and benefit of quantitative methods are widely known and accepted. (Patton, 1990). Researchers following a quantitative paradigm focus on objectivity and 'distance themselves from the people and social phenomenon they are studying' (Steckler et al., 1992, p.1). They tend to search for understanding through quantitative data, for example, from survey questionnaires.
with predetermined response categories and emphasise reliability, generalisability and objectivity.

Lincoln and Guba identify and discuss five axioms attributed to the naturalistic and rationalistic paradigms (1985, p.37). These are identified in Table 3.1.

**TABLE 3.1 Contrasting Positivist and Naturalist Axioms**

<table>
<thead>
<tr>
<th>Axioms About</th>
<th>Positivist Paradigm</th>
<th>Naturalistic Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>The nature of reality</td>
<td>Reality is single, tangible and fragmental</td>
<td>Realities are multiple, constructed, and holistic.</td>
</tr>
<tr>
<td>The relationship of knower to the known</td>
<td>Knower and known are independent, a dualism.</td>
<td>Knower and known are interactive, inseparable.</td>
</tr>
<tr>
<td>The possibility of generalisations</td>
<td>Time- and context-free generalisations (nomothetic statements) are possible.</td>
<td>Only time- and context-bound working hypotheses (ideographic statements) are possible.</td>
</tr>
<tr>
<td>The possibility of casual linkages</td>
<td>There are real causes, temporally precedent to or simultaneous with their effects.</td>
<td>All entities are in a state of mutual shaping, so that it is impossible to distinguish causes with effect.</td>
</tr>
<tr>
<td>The role of values</td>
<td>Inquiry is value-free.</td>
<td>Inquiry is value-bound.</td>
</tr>
</tbody>
</table>

Although in practice the “contrasts” are more subtle and less clearly demonstrated than the table suggests, it is of value in showing the broad characteristics in which research paradigms may differ.

The naturalistic (also known as qualitative) inquiry paradigm was adopted in this study for a variety of reasons. Lincoln and Guba (1985) argue that a paradigm is not chosen because it is always better, but rather it should be judged according to its fit to the characteristics of the phenomena being studied.
In relation to the five axioms in the table it is argued that a naturalistic approach is appropriate because students' and teachers' perceptions of mathematics and mathematics teaching are likely to vary greatly, to depend on their background and experience, and to change over time. In particular, the approach to this particular study was more naturalistic for the following reasons:

The decision to carry out research in the natural setting reflects the belief that realities are wholes that cannot be understood in isolation from their contexts. The multiple realities, which are teacher beliefs, are the focus of this study, they are the constructions that exist in the minds of individual people. No two individuals are exactly alike in feelings, drives or motions. Teacher trainees and practicing teachers thus were asked to give their own perceptions of the nature, teaching, and learning of primary mathematics through personal views, beliefs and feelings.

Among the different characteristics that may be properly associated with naturalistic inquiry, Owens (1995, p.260) identifies four characteristics as the 'salient- and, therefore, modal- characteristics of naturalistic inquiry'. Accordingly, "the term 'naturalistic' is used in referring to inquiries that:

1. primarily employs direct contact between investigators and actors in the situation as a means of collecting data,
2. use emergent strategies to design the study rather than a priori specification,
3. develop data categories from examination of the data themselves after collection, and
4. do not attempt to generalise the finding to the universe beyond that bounded by the study" (Owens, 1995, p.260).

The particular study that is presented here is concerned with the exploration and description of the perceptions of student teachers and teachers in relation to
primary mathematics and emphasises the importance of subjective experiences of individuals. The nature of the phenomenon being investigated here makes an exploratory inquiry which has the four characteristics associated with naturalistic inquiry which are depicted by Owens (1995) appropriate for the following reasons:

- Initially, direct contact between the researcher and the participants was through an oral presentation introducing the questionnaire. More significant contact was achieved through the semi-structured interviews.
- Secondly, semi-structured interviews were built around a core of structured questions and then branched off with emergent questions to explore in depth, without a prior specification of the branching questions;
- Thirdly, data categories were developed by examining the data only after its collection;
- Finally, the study was limited to the subjects chosen and did not attempt to generalise beyond the limits.

Thus, in keeping with the explorative and descriptive nature of the study of student teachers' and teachers' perceptions about the nature of the mathematics, and the teaching and learning of mathematics in primary schools in New South Wales, a qualitative perspective appears most appropriate.

### 3.3 Research Design

Although the previous section has established the appropriateness of a qualitative approach to the present study, in response to the question ‘which research approach is better, qualitative or quantitative?’, the most widely held position is that ‘there is no best method’ and ‘it all depends what you are studying and what you want to find out’ (Bogden & Biklen, 1998, p.39). ‘Both the qualitative and quantitative paradigms have weaknesses which, to a certain extent, are compensated for by the strengths of the others’ (Steckler et al, 1992, p.2). For example, the emphasis in qualitative research is on description and
explanation rather than on prediction. 'The great strength of qualitative research is the validity of the data obtained' (Hakim, 1987, p.37). However, that 'small numbers of respondents cannot be taken as representative', is a weakness of qualitative research, 'even if great care is taken to choose a fair cross-section of the type of people who are the subjects of the study' (Hakim, 1987, p.27).

Similarly, Peshkin (1993, p.28) contends that 'no research paradigm has a monopoly on quality; none can deliver promising outcomes with certainty; none have the grounds for saying "this is it" about their designs, procedures, and anticipated outcomes'. As Warwick (1973, p.190) says, 'every method of data collection is only an approximation to knowledge' and 'each provides a different and usually valid glimpse of reality' since 'all are limited when used alone'. Cohen and Manion (1989) advocate the use of a multi-method approach, thus enabling research to be strengthened. They also point out that exclusive reliance on one method 'may bias or distort the researcher's picture of the particular slice of reality he or she is investigating. Wise (1967, p.107) claims that "a combination of methods for collecting data will be the researcher's greatest assurance that he or she is compiling a complete picture objectively". Accordingly, the issue now is how they can be combined to produce strategies that are more effective. Steckler et al (1992) explain four different models in which qualitative and quantitative methods might be integrated in health education research and program evaluations:

1. A model in which qualitative methods are used initially to help develop quantitative measures.

2. A model in which a study or evaluation is predominantly quantitative, and qualitative results are used to help interpret and explain the quantitative findings.

3. A model that is the reverse of model 2 in that quantitative results are used to help interpret predominantly qualitative findings.

4. A model in which the two methodologies are used equally and parallel.
These models are illustrated in diagrams as follows:

**Model 1**
Qualitative methods are used to help develop quantitative measures and instruments.

**Model 2**
Qualitative methods are used to help explain quantitative findings.

**Model 3**
Quantitative methods are used to embellish a primarily qualitative study.

**Model 4**
Qualitative and quantitative methods are used equally and parallel.

*Figure 3.1*  Four possible ways that qualitative and quantitative methods might be integrated.
The model eventually chosen for this study is closest to Steckler et al's model 3. First, a largely quantitative survey of a large number of participants was administered. Results from the survey were used to guide a small number of semi-structured qualitative interviews to provide the detail and diversity of data that was central to the mode of the study. This may be represented as follows:

\[ \text{QUANTITATIVE} \rightarrow \text{QUALITATIVE} \rightarrow \text{RESULTS} \]

As there is no prototype that qualitative researchers must follow, a research design that is suitable for the exploration and description of the perceptions of students teachers and teachers in relation to primary mathematics, was created. The exploratory nature of the survey attempted to generate a broad overview of the range of student teachers' and practising teachers' perceptions of mathematics education, that is, to help determine student teachers' and practising teachers' perceptions in relation to primary mathematics. The descriptive nature of semi-structured interviews involved examining the phenomenon to more fully define it, that is, to explore the student teachers' and teachers' perceptions about primary mathematics education in more depth.

It was the requirement of the Wollongong Human Research Ethics Committee and of the Department of School Education Ethics Committee to submit the questionnaires and the interview schedules for their approval prior to data collection. Accordingly, the semi-structured interview questions were prepared after analysing the responses obtained in the pilot study of the questionnaires. However, the interviews were conducted only after administering the questionnaires and their analysis as represented in the above model.
3.4 Site and Participants

It is well accepted that 'the quality of a piece of research not only stands or falls by the appropriateness of methodology and instrumentation but also by the suitability of the sampling strategy that has been adopted' (Cohen, Manion & Morris, 2000, p.92). An overview of the description of site and participants of this study was presented in the introductory chapter. However, it is important to elaborate on the selection of site and participants at this point in order to provide a clear picture of the context of the study.

As Cohen, Manion and Morris (2000) state,

The selection of a sampling strategy must be governed by the criterion of suitability. The choice of which strategy to adopt must be mindful of the purposes of the research, the time scales and constraints on the research, the methods of data collection, and the methodology of the research. The sampling chosen must be appropriate for all of these factors if validity is to be served (p.104).

Accordingly, the exploratory and descriptive nature of the study as well as constraints of time, access, labour and resources determined the selection of site and participants in this investigation. As the researcher was enrolled in the Wollongong University as a doctoral student and as he was residing in Sydney, these factors were considered in identifying the constraints – time and resources – of this study. Thus, it was decided to carry out the study at the University of Wollongong and at four primary schools from two different areas of New South Wales – the Sydney Metropolitan area and the Illawarra area. To include a variety of types of school, two public primary schools, one from each area under selection, one Catholic primary school in the Illawarra area, and one independent private primary school in the Sydney Metropolitan area were chosen.
Firstly, principals were contacted by telephone to get their consent prior to getting approvals from the New South Wales Department of Education and Training as well as from the Catholic Education office of the Diocese of Wollongong. Once the approvals had been obtained, the principals were approached to identify participants who could volunteer in the study.

A participation information sheet was sent to each principal. This information sheet (Appendix A) provided the participants with details about their rights and about the purpose, method, demands and risks of the study. After having discussions with their staff to explain the purpose and mode of study, the principals of the four schools informed the researcher about the number of practising teachers who could be involved in the study.

A total of 34 practising teachers (12 from the Sydney Metropolitan area public primary school, 8 from the Illawarra area public primary school, 8 from the Catholic primary school in Illawarra area and 6 from the independent private primary school) gave their consent to take part in the study. Informed consent from each subject was obtained in writing (Appendix B). Information supplied included the following:

- the focus of the research,
- the types of data collection being taken,
- the statement that the participation was voluntary,
- confirmation that the subjects were free to refuse and free to withdraw from participation at any time,
- assurance that the participants' anonymity and confidentiality would be maintained,

and

- names and contact numbers of the researcher, his supervisors, and secretary of the Human Ethics Committee, Wollongong University (Appendix B).
The cohort of teachers varied in experience from less than 2 years to more than 20 years. They held professional positions as full-time classroom teacher, casual classroom teacher, executive teacher, assistant principal, principal, permanent part-time teacher and special education teacher. They were also teaching at year levels from Kinder to Year 6. More details are presented in chapter 4.

The second group of subjects, the cohort of teacher trainees, was from Wollongong University. As the beliefs held by teacher trainees of mathematics have been developed and influenced by their own education and through their reflective practice, to include a wide range of students with different years of experience as students, 1st year, 2nd year, 3rd year and 4th year students in the B.Ed program at Wollongong University were approached. The purpose of this study was explained in their lectures before the commencement of their lectures and their consent was obtained in writing (Appendix B). A total of three hundred and sixty-one 1st to 4th year students participated in the study by responding to the questionnaire.

3.5 Data Collection Procedures

3.5.1 Introduction

One of the characteristics of a naturalistic investigation is that 'it provides an emergent plan for a highly interactive process of gathering data from which analysis will be developed' (Owens, 1995, p.264). This is because 'data collection and analysis go on simultaneously, with the analysis giving direction to the data collection by suggesting what to check, when to seek confirmation, and how to extend the data collection itself' (Owens, 1995, p.264).

In inquiring into the perceptions of teacher trainees and practising primary teachers in relation to the nature of mathematics in primary schools in New South Wales, the methods of data collection were classified into two categories:
1. Data collection from human sources; and

2. Data collection from non-human sources.

As examples of interaction between analysis and data collection, data of type 2 (from documentation) influenced type 1 (survey) while analysis of the survey in turn influenced the interview process.

In this particular study the emphasis was on the first category and included significant use of what Lincoln and Guba (1985) refer to as “Human as Instrument” (p.193), that is, the researcher is the ‘instrument’ used directly to collect data. Lincoln and Guba (1985,p.193) have discussed the different characteristics of the human as an instrument in naturalistic inquiry. These can be summarised as follows:

1. The assumption of responsiveness – The human as instrument can sense and respond to personal and environmental cues. The human interacts and make them explicit.

2. Although the trade-off between perfection and adaptability suggests that instruments that are perfect for assessing one factor may be useless for assessing another factor, the human can collect information about multiple factors, and at multiple levels, simultaneously.

3. The human instrument has the ability to process data as soon as they become available, to generate hypotheses on the spot, and to test these hypotheses with the respondents in the very situation in which they are created.

4. The human-as-instrument has the opportunity to summarise data and feed it back to the respondent for clarification.
Keeping the above factors in mind, two different data collection techniques were employed in this study. The first was a researcher-designed questionnaire and the other involved semi-structured interviews with a subset of subjects who responded to the survey questionnaire. The interviews were used to follow up insights gained from the survey results into the perceptions of student teachers and practising teachers about primary mathematics education [an example of Owen's notion of the 'emergent plan' (Owen, 1995, p.264)]. It was at this stage of the data collection that use was made of the “human as instrument”. These two data collection techniques are further explained in detail below.

3.5.2 The Questionnaire

3.5.2.1 Preparation of the questionnaire

A questionnaire is considered an appropriate method of collecting information in one or more of the following circumstances (Deschamp & Tognolini, 1983, p.1):

- Information is required from a large number of people;
- Information is required from people dispersed geographically;
- Respondents are given the security of anonymity;
- Insufficient time or resources are available for less impersonal methods of collecting information.

As the study was based on generating a broad overview of the range of student teachers' and practising teachers' perceptions about primary mathematics education, the information had to be collected from a large number of student teachers and practising teachers of different areas. It was a principle of the New South Wales Department of Education that the 'test results and other confidential data must not be disclosed in any way which might lead to the identification of the individuals' and the 'data should be collected in a form in which individuals or schools cannot be identified' (1996, p.3). In addition, the Human Research Ethics
Committee of University of Wollongong insists that researchers establish a clear and fair agreement with participants, where respondents are informed of research outcomes, where there is informed consent about all aspects of the investigation, and where participants have a right to confidentiality and anonymity. Further, as this study was to fulfill the requirement of a Doctor of Education Research Degree, the time limits for the degree were also considered. These factors reflect the circumstances discussed by Deschamp and Tagolini and support the choice of the questionnaire as an appropriate method of collecting information.

### 3.5.2.2 Format of the questionnaire

In describing the process of operationalising a questionnaire Cohen, Manion and Morris contend that the approach used should recognise "the need to ensure that the questionnaire

1. is clear on its purposes,
2. is clear on what needs to be included or covered in the questionnaire in order to meet the purposes;
3. is exhaustive in its coverage of the elements of inclusion;
4. asks the most appropriate kinds of question;
5. elicits the most appropriate kinds of data to answer the research purposes and sub-questions;

Two different sets of questionnaires were used to collect data from practising teachers and prospective teachers respectively. Both questionnaires consisted of two parts. The first part (Part A) was designed to collect relevant demographic and biographical details about each teacher or student teacher, and about their school or course of study. This part contained questions pertaining to general background characteristics such as gender, age range, type of school or year of enrollment, teacher qualifications, years of teaching experience and the like.
The second part (Part B) of the teacher-questionnaire contained questions to gather information about the highest level of formal mathematics education of practising teachers and their preservice training. The questionnaire also included questions to gather information from practising teachers regarding their professional profile and conceptions and beliefs about mathematics education, mathematics teaching and mathematics learning in primary. These questions were concerned with the teachers’ perceptions of the following areas:

- the nature of mathematics,
- mathematics teaching,
- mathematics learning and its assessment,
- resources for learning,
- mathematics curriculum in New South Wales,
- working environment,
- professional responsibility.

The above areas had been identified through researching the literature related to primary mathematics education as stated in Chapter 2.

The two basic types of questions that were used in the questionnaire were closed and open-ended. Closed questions were used when all the possible, relevant responses could be specified and the number of possible responses was limited. Open-ended questions were used when there were a great number of possible answers or when it was not possible to predict all the possible answers. Both formats were used in some questions with a number of closed questions followed by "other" as the last possible response. The open-ended questions were provided with a number of lines where respondents could write points, sentences or short paragraphs. It was intended that the number of lines provided an indication of desired length of answer.
Accordingly, the following types of item formats were used in structuring the questions:

1. "Choose an alternative" type
   -- This type of item format asked the respondents to choose between alternative responses.

2. "Supply specific information" type
   -- This type of item format contained completion – or fill-in items that were open-ended questions to which respondents must supply their own answers in their own words.

3. "Assign a value" type
   -- Scaled items were included to rate a concept, event, or situation on such dimensions such as quantity or intensity, indicating "how much"; on quality indicating "how well", or on frequency indicating "how often". The respondents were required to select from one of five alternatives on a Likert-type scale, for example,

\[
\begin{align*}
1 & \text{ little range} \\
2 & \text{ some range} \\
3 & \text{ normal range} \\
4 & \text{ large range} \\
5 & \text{ extreme range}
\end{align*}
\]

The questionnaire for student teachers (Appendix C) contained only those questions from the teacher-questionnaire that were relevant to prospective teachers, for example, questions which explored the perceptions on the nature of mathematics, mathematics teaching and mathematics learning. Questions related to classroom practice and working environment were left out.
3.5.2.3 The pilot study

Before the questionnaire in its present form was finalised, several steps were taken to make the questionnaire as appropriate and effective as possible. Firstly, a pilot version was prepared.

It is often hard to see your own mistakes, particularly with instructions on how to complete a questionnaire. The researchers know what they want and may be oblivious to the lack of, or ambiguous instructions they have provided. The clarity, length, spacing, structure and instructions of a questionnaire can all be evaluated through a pilot study (Wilson & McLean, 1994).

A pilot study, Eichelberger (1989, p.134) believes, is "absolutely essential" as it is carried out to identify any problems or ambiguity in its items, so that the subjects in the main study will experience no difficulties in completing it. It is also used to assess the validity in the questions. This step is essential in order to make the questionnaire as clear and as understandable as possible. Cohen and Manion (1995) describe the importance of this clarity:

An ideal questionnaire possesses the same properties as a good law. It is clear, unambiguous and uniformly workable. Its design must minimise potential errors from respondents ... and coders. And since people's participation is voluntary, a questionnaire has to help in engaging their cooperation and eliciting answers as close as possible to the truth (p.103).

The pilot version was used with two teachers from two other schools than those under study. The completed questionnaires were discussed with the two teachers by the researcher. The final version of the questionnaire (Appendix D) was prepared by taking both the results and the teachers' comments into account. In particular, the wording of a small number of questions was changed to clarify the meaning (Appendix D).
3.5.3 Semi-structured Interview

Kvale (1996) provides a definition of interview:

An interview is literally an inter view, an interchange of views between two persons conversing about a theme of mutual interest (p.2).

Cohen, Manion and Morris (2000) give a similar definition but with specific reference to research as:

a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information focused by him or her on content specified by research objectives of systematic description, prediction or explanation (p.269).

Accordingly, the purpose of interviewing is to allow us to enter into the other person’s perspective. By providing access to what is inside a person’s head, it is possible to explore what a person knows, what a person likes or dislikes and what a person thinks in terms of attitudes and beliefs (Tuckman, 1972, cited in Cohen & Manion, 2000, p.268).

Among the different types of interviews such as structured interview, semi-structured interview, unstructured interview and focus group interview, semi-structured interview was chosen as the most appropriate method for collecting data for this study. Semi-structured interviews are built around a core of structured questions from which the interviewer branches off to explore responses in depth. Although a semi-structured interview is one that consists of questions worked out by the researcher in advance, the interviewers are free to modify the order of these questions based on their perception of what seems most appropriate in the context of the conversation. The interviewer ‘can also change the way the questions are worded, give explanations, leave out particular questions which seem inappropriate with a particular interviewee or include additional ones’ (Robson, 1993, p.231). This type of loosely structured interview format is of use to help respondents express their views of a phenomenon in
their own terms and draws on the strengths of the “Human as Instrument” (Lincoln & Guba, 1985).

Two different sets of semi-structured interview questions were worked out for practising teachers and student teachers based on the responses obtained in the pilot study of the questionnaire. Questions were posed, inter alia, on their beliefs and conceptions about primary mathematics, mathematics learning, and mathematics teaching (Appendices E & F).

The teachers for the semi-structured interviews were selected from the respondents to the questionnaire to include a variety of types of teachers. For example, a principal, a special educator and a teacher with extreme experience were chosen. In this way, 12 practising teachers, three from each school, were selected. This type of purposive sampling was based on the ‘researcher’s judgment as to typicality or interest’ (Robson, 1993, p.1410).

Among the 361 student teachers, 12 student teachers, three from each Year level, were interviewed. The selection of these subjects was on a voluntary basis. Each subject was interviewed once, at a time, which was convenient to him or her. Each interview took about half an hour. Each interview was audiotaped and transcribed.

Pseudonyms were allocated to each of the teachers and student teachers who participated in the semi-structured interview.

3.5.4 Data Collection from Non-human Sources

Data collection from non-human sources took the form of the curriculum documents and policy documents that were made available by the Department of School Education in New South Wales. Legal statements and policies regarding primary mathematics were identified from these documents and the analysis of
these statements and policies was carried out to gain a broad understanding of the current beliefs, opinions and learning theories advocated and promoted by the New South Wales Department of Education. The document analysis of the curriculum documents and policy documents was used in the design of the questionnaire and the interview schedule and to support the qualitative data analysis.

3.5.5 The researcher’s journal

Throughout the study, a journal was kept by the researcher. This journal documented a range of reflections covering thoughts, ideas and understandings about the nature of mathematics education in NSW, notes about the researcher as a learner, thinking and responses of the researcher to the literature he was reading on the subject of the study, methodological decisions about the research design, the written and oral responses of the participants and about the data analysis, the researcher's personal feelings and frustrations when difficulties were encountered in the running of the study.

Although these reflections were not recorded on a regular basis, the important records helped the researcher to articulate his ideas about the study. These records were written in the researcher's mother tongue – Tamil.

3.6 Data Analysis

3.6.1 Introduction

The information collected with different instruments will not be of use if it does not make sense (Wallen & Fraenkel, 2001). The process of interpreting research goes beyond the mere collection and tabulation of factual data. Accordingly, qualitative and quantitative data analysis were used to present, describe, analyse and interpret the results from the two data collection methods – the questionnaire and the semi-structured interview.
3.6.2 An overview of data analysis

In attempting to generate a broad overview of the range of student teachers' and teachers' perceptions about primary mathematics education, and to examine those perceptions in more detail, the first step involved in the data analysis was to tabulate the procedures involved with the study. These procedures are outlined in Table 3.2.

**TABLE 3.2 STRUCTURE OF THE STUDY**

<table>
<thead>
<tr>
<th>DATA COLLECTION PROCEDURES</th>
<th>FOCUS</th>
<th>DATA RECORDING PROCEDURES</th>
<th>DATA PREPARATION PROCEDURES</th>
<th>DATA ANALYSIS PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>Teachers' and student teachers' perceptions about primary mathematics education -- generation</td>
<td>Questionnaire completion</td>
<td>1 Tabulation of fixed responses</td>
<td>1 Quantitative -- Traditional tools of descriptive statistics -- Chi-square test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Tabulation of nominal data in cross break tables</td>
<td>2 Qualitative -- Thematisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 Tabulation of open-ended responses</td>
<td></td>
</tr>
<tr>
<td>Semi-structured interview</td>
<td>Examining the perceptions in more detail</td>
<td>Audio-taping the interviews</td>
<td>Transcribed responses</td>
<td>Qualitative -- summarising of each subject's perceptions and thematisation</td>
</tr>
</tbody>
</table>

3.6.3 The Questionnaire

Quantitative data from the questionnaire was collated and presented in tabular form. Descriptive statistics were calculated to assess overall perceptions of teachers and student teachers. The traditional tools of descriptive statistics – frequency distribution, cross-tabulation etc – were used in the analysis of the fixed response questions. Chi-square statistics were then used to identify any differences by status of participants, student level and school type.
It is recommended that 'chi-square is a simple non-parametric test of significance, suitable for nominal data where observations can be classified into discrete categories and treated as frequencies' (Burns, 2000, p.212). In addition, 'the chi-square tests hypotheses about the independence (or alternatively the association) of frequency counts in various categories' (p.212). In other words, the hypotheses with the usual notations are:

\[ H_0 : \text{the variables are statistically independent} \]
\[ H_1 : \text{the variables are statistically dependent}. \]

These hypotheses were tested using the formula

\[
\chi^2 = \sum \frac{(O - E)^2}{E},
\]

where

\( O \) = observed frequency;
\( E \) = expected frequency; and
\( \sum \) = the summation over all categories that were measured.

Two types of chi-square tests were used:

1. Goodness-of-fit chi-square
2. Chi-square test of the independence of categorical variables (cross classification).

The goodness-of-fit chi-square test revealed how well an observed distribution fitted a hypothesised or theoretical distribution. The chi-square tests of independence (contingency tables) examined whether any significant difference occurred due to different categories considered.

In the case of open-ended questions, all responses of questions were analysed. Categories were formulated and labeled and connections between categories were sought to identify themes.
3.6.4 Semi-structured Interview

The purpose of the data analysis was to reconstruct the data in some meaningful way. To this end, the analysis of the semi-structured interview data employed a number of different analytic steps. Firstly, all semi-structured interviews were recorded and transcribed verbatim. This provided a comprehensive view, overcoming the possibility of bias in terms of transcribing comments specifically related to preconceived notions about the study's research questions. The transcripts were then coded and recorded under categories, which emerged from the data. These categories were influenced by the researcher's presuppositions, knowledge of the literature, reflective journal, experience etc. During this coding process, categories were modified and added to and data regrouped several times.

Interpretations of meanings were then made as much as possible to delineate units of general meaning and then units of meaning relevant to the research questions. Redundancies were eliminated to cluster units of relevant meaning and to determine themes for these. The process was continued by writing a summary of each interview for each subject to incorporate the themes relevant to the data. General and unique themes for all interviews were then identified. The final process in analysing the interviews was contextualising the themes and composing a summary to capture the essence of the phenomenon being investigated. This process of analysing the interview was adopted from Cohen, Manion and Morrison (2000, pp.283 - 286).

3.6.5 Documents

An analysis of the curriculum documents and policy documents was carried out in support of the construction of the survey questionnaire and semi-structured interview questions and of the qualitative data analysis. Detailed, written descriptions of policies, policy statements, goals, emphases and plans contained
in these documents were analysed with a focus on support for the findings from its qualitative data.

3.7 Quality of Data

The traditional hallmark of good research is the extent to which validity and reliability, and objectivity have been ensured and maintained. Lincoln and Guba (1985) believe that the concepts of reliability and validity are not congruent with a naturalistic paradigm and they have therefore proposed four analogous concepts, which they argue, are compatible with naturalistic inquiry. These are credibility, transferability, dependability and confirmability. These alternative concepts describe the way that trustworthiness can be ensured. As measures of credibility and trustworthiness form an integral part of the inquiry process, precautions were taken to ensure that the findings and the interpretations of the data of this study maintained a high level of credibility and trustworthiness. Procedures such as triangulation of data, audit trials, peer consultation, member checks, referential adequacy materials, thick description and prolonged data gathering are suggested by Lincoln and Guba (1985) as control to these measures to enhance trustworthiness.

A multi-method approach of collecting data was utilised in this inquiry into the perceptions of teachers and student teachers in relation to primary mathematics. This multi-method approach can be referred to as a type of triangulation. Triangulation is defined as 'the use of two or more methods of data collection in the study of some aspect of human behaviour (Cohen, Manion & Morrison, 2000, p.112). Triangulation of data is crucially important in naturalistic studies. Lincoln and Guba (1985) argue that as the study unfolds and particular pieces of information become known, steps should be taken to validate each against at least one other source or a second method. The more the methods contrast with each other, the greater the researcher's confidence. In this particular study, for
example, certain outcomes of the questionnaire corresponded to those of the semi-structured interview method. 'When this occurs, the researchers will be confident about the findings' (Cohen, Manion, 1989, p.270).

Reliability checks were also apparent in individual methods. For example in the teacher questionnaire, question 7.1 and question 7.3 used two quite different approaches to elicit information on a single issue. Question 7.1 asked to place ticks against the materials listed which were used in maths teaching whereas question 7.3 asked them to list three most important teaching materials they used to teach primary mathematics.

Member checking was also used to enhance the reliability and validity of the data. Lincoln and Guba (1985) see member checking in it as vital in satisfying the truth-value criterion. Consequently, by taking the audiotape interview back to the interviewees and allowing them to respond, the researcher became much more confident about the validity of the data.

In the case of questionnaires, actual pilot studies were carried out to help identify and correct any problems of ambiguity and confusion. This helped provide more reliable and credible data for the final questionnaire and gave some indication of what could be the basis of further in-depth questions at the interview stage.

Further, a naturalistic paradigm acknowledges the inescapable influences of subjectivity in this kind of inquiry but emphasises the importance of taking certain precautions, which might otherwise allow the research to degenerate into relativism. Two initiatives were instigated in this study to ensure a system of 'controlled subjectivity'. For the first, as the researcher was aware that subjectivity operates during the entire research process, by 'being mindful of its enabling and disabling potential' (Peshkin, 1988, p.180) it was possible to make these understandings explicit. Secondly, the researcher was 'being mindful' by actively seeking out and responding to personal subjectivity by making a
subjectivity audit conducted through a personal reflective journal in which a systematic monitoring of self as a researcher was followed (Peshkin, 1988).

3.8 Conclusion

The research methodology used in the study of perceptions of student teachers and practising teachers about the nature of mathematics, mathematics teaching, and mathematics learning in relation to primary mathematics was chosen due to its fit with the data that was studied. This involved the use of qualitative methods supported by quantitative methods. Whilst this chapter has justified and explained the research design, the data collection procedures, the data analysis procedures and the methodological basis, the next chapter presents an analysis of the quantitative data obtained from the survey questionnaires.
Chapter 4

ANALYSIS OF THE QUESTIONNAIRE DATA

4.1 Introduction

The aim of this chapter is to analyse the quantitative data obtained from the questionnaires. Characteristics such as age, gender, student status, professional position in school, professional qualifications and the like are examined with the help of traditional tools of descriptive statistics such as column graphs, mean, standard deviation, chi square, frequency distribution, cross-tabulation etc.

Further, the mathematics background, adequacy of training and experience of the subjects of this study were examined using descriptive statistics and Chi Square statistics. A quantitative analysis of different views about the emphasis on mathematics education was also carried out to examine their conceptions of the nature of primary mathematics teaching.

Finally, the data that dealt with the student teachers' and practising teachers' perceptions of the nature of mathematics, mathematics teaching, mathematics learning and its assessment, mathematics curriculum in New South Wales, working environment, and professional responsibility were analysed with Chi
Square statistics to identify any difference across different factors such as status of participants, student level and school type.

### 4.2 Personal Characteristics

#### 4.2.1 Sample Distribution

The questionnaire was administered to preservice student teachers (STs) in the Bachelor of Teaching / Bachelor of Education program at the University of Wollongong, and to 34 practising teachers (PTs) of Sydney Metropolitan area and the Illawarra area. All students in the four years of undergraduate study were invited to participate in the study in their normal class time for lectures. Three hundred and sixty-one students responded to the questionnaire from a total population of 593, so the total number of completed surveys represents a response rate of 61 percent. The compositions of samples are given in Table 4.1 and Table 4.2.

<table>
<thead>
<tr>
<th>Year level</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>125 (35%)</td>
<td>124 (34%)</td>
<td>52 (14%)</td>
<td>60 (17%)</td>
<td>361</td>
</tr>
<tr>
<td>Enrolment</td>
<td>150 (25%)</td>
<td>174 (29%)</td>
<td>174 (29%)</td>
<td>95 (16%)</td>
<td>593</td>
</tr>
<tr>
<td>Response rate</td>
<td>82%</td>
<td>70%</td>
<td>30%</td>
<td>63%</td>
<td>61%</td>
</tr>
</tbody>
</table>

| Observed frequency | 125 | 124 | 52 | 60 |
| Expected hypothetical frequency | 91 | 106 | 106 | 58 |
The Goodness-of-fit Chi Square test revealed that there was a highly significant difference between the sample and the cohort in the distribution across the year level of study (chi square = 43.34, p = 0.0001). This might have occurred because the response rate of the participants from 3rd year was low. This low response rate could be accounted by the fact that the questionnaires from 1st year, 2nd year and 4th year student teachers were collected on the spot where they were distributed while the questionnaires from the 3rd year student teachers were collected at a later time.

Table 4.3: Composition of sample by sector & by location – Practising Teachers

<table>
<thead>
<tr>
<th></th>
<th>Government schools</th>
<th>Non-government schools</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>12 (34%)</td>
<td>6 (18%)</td>
<td>18 (53%)</td>
</tr>
<tr>
<td>Metropolitan area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illawarra area</td>
<td>8 (24%)</td>
<td>8 (24%)</td>
<td>16 (47%)</td>
</tr>
<tr>
<td>Total</td>
<td>20 (59%)</td>
<td>14 (41%)</td>
<td>34 (100%)</td>
</tr>
</tbody>
</table>

4.2.2 Composition of sample by age

The sample of student teachers ranged in age from 17 years to 54 years with 23% classified as mature age students, ie over 24 years of age. Table 4.4 gives details of the age distribution of the sample, which had a mean of 24 years and a standard deviation of 6.6 years. The cohort of student teachers enrolled in BEd / B Teach had a mean of 24.5 years and a standard deviation of 7.1 years.
Table 4.4: Age distribution of the sample – Student Teachers

<table>
<thead>
<tr>
<th>Age</th>
<th>Sample (N = 361)</th>
<th>Enrolment (N = 593)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>17 - 24</td>
<td>279</td>
<td>77</td>
</tr>
<tr>
<td>25 - 34</td>
<td>44</td>
<td>12</td>
</tr>
<tr>
<td>35 - 44</td>
<td>33</td>
<td>9</td>
</tr>
<tr>
<td>45 - 54</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>24 years</td>
<td>24.5 years</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>6.6 years</td>
<td>7.1 years</td>
</tr>
</tbody>
</table>

Table 4.5: Distribution of sample – Student Teachers

<table>
<thead>
<tr>
<th>Age</th>
<th>17 – 24</th>
<th>25 – 34</th>
<th>35 – 44</th>
<th>45 – 54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed frequency</td>
<td>279</td>
<td>44</td>
<td>33</td>
<td>5</td>
</tr>
<tr>
<td>Expected hypothetical frequency</td>
<td>257</td>
<td>59</td>
<td>39</td>
<td>6</td>
</tr>
</tbody>
</table>

The Goodness-of-fit Chi Square test revealed that there was no significant difference between the sample and the cohort across age range (chi square = 6.79, p = 0.079). This shows that the sample considered is similar to the cohort enrolled and confirms that the sample is a valid sample in terms of age. Table 4.6 presents the age distribution by year levels.
### Table 4.6: Age distribution of the sample by year level – Student Teachers

<table>
<thead>
<tr>
<th>Age range</th>
<th>1st Year (N = 12)</th>
<th>2nd Year (N = 124)</th>
<th>3rd Year (N = 52)</th>
<th>4th Year (N = 60)</th>
<th>Total (N = 361)</th>
<th>Enrolment (N = 593)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>17 - 24</td>
<td>94</td>
<td>75</td>
<td>100</td>
<td>80</td>
<td>279</td>
<td>77</td>
</tr>
<tr>
<td>25 - 34</td>
<td>18</td>
<td>14</td>
<td>8</td>
<td>7</td>
<td>44</td>
<td>12</td>
</tr>
<tr>
<td>35 - 44</td>
<td>11</td>
<td>9</td>
<td>14</td>
<td>11</td>
<td>33</td>
<td>9</td>
</tr>
<tr>
<td>45 - 54</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>23.9</td>
<td>23.7</td>
<td>24.6</td>
<td>22.6</td>
<td>23.7</td>
<td>24.5</td>
</tr>
<tr>
<td>Std.Dev</td>
<td>6.7</td>
<td>7.0</td>
<td>7.3</td>
<td>4.6</td>
<td>6.6</td>
<td>7.1</td>
</tr>
</tbody>
</table>

When Chi Square was calculated for the age distribution across year levels, no significant difference was found (chi square = 9.88, p = 0.130) in the age distribution across year levels of student teachers. The majority of the student teachers (77%) were aged from 17 years to 24 years. This was also represented in similar proportions within the different year levels (1st Year – 75%, 2nd Year – 80%, 3rd Year – 71%, 4th Year – 80%).

The age distribution of practising teachers in the sample is given in Table 4.7. As the sample was small in number (N = 34), many of the cells in the table were smaller in number than required for a valid Chi Square test.

### Table 4.7: Age distribution of the sample – Practising Teachers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>17 - 24</td>
<td>5</td>
<td>42</td>
<td>1</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>25 - 34</td>
<td>4</td>
<td>33</td>
<td>3</td>
<td>50</td>
<td>1</td>
</tr>
</tbody>
</table>
An analysis of data in Table 4.7 reflect that the teachers in the Illawarra tend to remain in their positions until retirement while the Sydney teaching population is more mobile.

It was also observed that about three quarters or more of the student teachers in the sample were under 24 years of age while about three quarters of the practising teachers in the sample were over 24 years.

4.2.3 Composition of sample by gender

Composition of sample by gender is given in Table 4.8 and Table 4.9.

Table 4.8: Gender distribution of the sample – Student Teachers

<table>
<thead>
<tr>
<th>Gender</th>
<th>1st Year (N = 125)</th>
<th>2nd Year (N = 124)</th>
<th>3rd Year (N = 52)</th>
<th>4th Year (N = 60)</th>
<th>Total (N = 361)</th>
<th>Enrolment (N = 593)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Female</td>
<td>112</td>
<td>90</td>
<td>104</td>
<td>84</td>
<td>47</td>
<td>90</td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
<td>10</td>
<td>20</td>
<td>16</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 4.9: Gender distribution of the sample – Practising Teachers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>100</td>
<td>6</td>
<td>100</td>
<td>6</td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

An analysis of the tables shows that the sample, like the profession of primary school teacher, is dominated by women. This is also represented among the prospective teachers in the sample and in the student cohort enrolled at Wollongong University. Eighty-six per cent of the student teachers in the sample were females while 81 per cent of the student cohort was a female. This similarity is also represented in each year level – 1st Year: 90%, 2nd Year: 84%, 3rd Year: 90% & 4th Year: 78%. This similarity is in agreement with the well-known phenomenon of the continuing increase in the percentage of women in the teaching profession, at least in the lower levels of teaching in all western countries.

4.2.4 Student status and professional position

There were full-time and part-time student teachers in the sample. Their distribution among different year levels is given in Table 4.10.
Table 4.10: Composition of sample by status – Student Teachers

<table>
<thead>
<tr>
<th>Student status</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year (N = 125)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year (N = 124)</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year (N = 52)</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; Year (N = 60)</th>
<th>Total (N = 361)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Full-time</td>
<td>115</td>
<td>92</td>
<td>121</td>
<td>98</td>
<td>51</td>
</tr>
<tr>
<td>Part-time</td>
<td>10</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.10 shows that 93% of student teachers in the sample were enrolled as full-time students while the number of full-time student teachers in the 4<sup>th</sup> year study level was only 78%. This is because some of the student teachers go to part-time jobs or to other commitments after their third year of study.

Table 4.11 shows the distribution of different professional positions that the practising teachers in the sample held in their schools.

Table 4.11: Positions held in schools – Practising Teachers

<table>
<thead>
<tr>
<th>Professional Position</th>
<th>Actual number in the sample</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Assistant Principal</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Executive Teacher</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Full-time Classroom Teacher</td>
<td>19</td>
<td>55</td>
</tr>
<tr>
<td>Casual Classroom Teacher</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Permanent Part-time Teacher</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Special Education Teacher</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
As the practising teachers in the sample are from all different sorts of positions like age, gender, professional qualifications, different views about the nature of mathematics, mathematics teaching and mathematics learning may be obtained.

### 4.2.5 Professional qualifications and current year levels

The educational and professional qualifications held by the practising teachers in the sample are reported in Table 4.12.

<table>
<thead>
<tr>
<th>Highest Teacher Education Qualification</th>
<th>Actual number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three year trained</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Dip Teach</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>B Ed / B Teach</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>GDE / Dip Ed</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Diploma in Teaching upgraded to B Ed</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>M Ed</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note: 1 missing case*

Table 4.12 shows that nearly two-thirds of the practising teachers in the sample had a degree in education or teaching, or a degree with diploma in teaching. Although there were about 20% of casual classroom teachers, all had at least the minimum qualification for teaching, which is a legal requirement.
Table 4.13 shows the current year levels of the practising teachers’ classes. The practising teachers in this sample teach different groups representing every primary class.

### Table 4.13: Current year level of practising teachers

<table>
<thead>
<tr>
<th>Current year level</th>
<th>Actual number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinder</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>Year K / 1</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Year 1</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>Year 1 / 2</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>Year 2</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>Year 2 / 3</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Year 3</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Year 4</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>Year 4 / 5</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>Year 5</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>Year 5 / 6</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>Year 6</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>11.8</td>
</tr>
</tbody>
</table>

### 4.2.6 Teaching experience and employment experience

The teaching experience of practising teachers in the sample is reported in Table 4.14. Mean is calculated from raw scores for each school.
Table 4.14: Distribution of Teaching Experience of Practising Teachers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1 to 5</td>
<td>5</td>
<td>42</td>
<td>4</td>
<td>67</td>
<td>0</td>
</tr>
<tr>
<td>6 to 10</td>
<td>4</td>
<td>33</td>
<td>1</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>11 to 20</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>2</td>
<td>17</td>
<td>1</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td>10.7 years</td>
<td></td>
<td>7.1 years</td>
<td></td>
</tr>
<tr>
<td><strong>Std. Dev.</strong></td>
<td></td>
<td>10.9 years</td>
<td></td>
<td>8.1 years</td>
<td></td>
</tr>
</tbody>
</table>

On average, the teachers from the Wollongong Catholic primary school in the sample had been teaching in their current posts for considerably longer than the teachers from other schools (mean = 22.2 years, standard deviation = 8.3 years), while the teachers from the Sydney independent school had been teaching for a shorter period than the teachers from other schools in the sample (mean = 7.1 years, standard deviation = 8.1 years).

When the data was analysed by government and non-government schools, teachers from government schools had a mean of 15.3 years with a standard deviation of 11.4 years while non-government school teachers had a mean of 11.2 years with a standard deviation of 7.8 years. However, differences that are far more striking emerge between the two cohorts if the schools were grouped by location into Sydney Metropolitan area schools and Illawarra area schools. On average, the mean value for experience of the practising teachers from Illawarra area schools was 18.3 years with a standard deviation of 8.2 years while this mean value for the teachers from Sydney Metropolitan area schools
was nearly half the value of Illawarra area school teachers (mean = 9.5 years, standard deviation = 10.2 years). This again reflects the popularity of posting to Illawarra as opposed to Sydney schools.

As mathematics provides important tools for use at the personal, civic and vocational level, employment experience could also help the student teachers develop positive attitudes towards mathematics learning and teaching. Employment experience of student teachers in the sample is shown in Table 4.15.

Table 4.15: Employment experience of Student Teachers

<table>
<thead>
<tr>
<th>Year Level (N)</th>
<th>Part-time only</th>
<th>Full-time only</th>
<th>Part-time &amp; full-time</th>
<th>Not available</th>
<th>3 or more years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Yr. (125)</td>
<td>69</td>
<td>20</td>
<td>14</td>
<td>22</td>
<td>62</td>
</tr>
<tr>
<td>2nd Yr. (124)</td>
<td>83</td>
<td>9</td>
<td>14</td>
<td>18</td>
<td>63</td>
</tr>
<tr>
<td>3rd Yr. (52)</td>
<td>22</td>
<td>4</td>
<td>9</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>4th Yr. (60)</td>
<td>34</td>
<td>8</td>
<td>1</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Total (361)</td>
<td>208 (58%)</td>
<td>41 (11%)</td>
<td>38 (11%)</td>
<td>74 (20%)</td>
<td>161 (45%)</td>
</tr>
</tbody>
</table>

Table 4.15 shows that 80% of the student teachers in the sample had part-time or full-time employment experience while 45% had employment experience of 3 years or more.

4.3 Mathematics Background and Training

4.3.1 Level of study of formal mathematics and high school mathematics
In order to determine the level of study of formal mathematics, practising teachers and student teachers were asked to indicate the highest level at which they had formally studied mathematics. Table 4.16 provides the data.
Table 4.16: Highest level of study of formal mathematics

<table>
<thead>
<tr>
<th>Year Level</th>
<th>Level of study of formal mathematics</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 10</td>
<td>HSC</td>
<td>Tertiary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (N = 125)</td>
<td>13</td>
<td>10</td>
<td>108</td>
<td>86</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (N = 124)</td>
<td>7</td>
<td>6</td>
<td>112</td>
<td>90</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (N = 52)</td>
<td>4</td>
<td>8</td>
<td>47</td>
<td>90</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (N = 60)</td>
<td>1</td>
<td>2</td>
<td>56</td>
<td>93</td>
</tr>
<tr>
<td>Student Teachers (361)</td>
<td>25</td>
<td>7</td>
<td>323</td>
<td>89</td>
</tr>
<tr>
<td>Practising Teachers (34)</td>
<td>3</td>
<td>9</td>
<td>18</td>
<td>53</td>
</tr>
</tbody>
</table>

It was found that 89% of the student teachers but only 53% of the practising teachers had HSC as their highest level of formal mathematics and this is consistent with the fact that HSC mathematics is now a requirement to become a primary teacher.

Table 4.17 provides information about the highest level of study of high school mathematics. This table shows that 21% of the practising teachers in the sample did not study HSC mathematics, while only 10% of the student teachers in the sample did not study HSC mathematics. This may be because HSC mathematics is now a requirement for primary mathematics.
Table 4.17: Level of study of high school mathematics

<table>
<thead>
<tr>
<th>Year Levels</th>
<th>Year 10</th>
<th>HSC (Total)</th>
<th>2 Unit maths</th>
<th>3 Unit maths</th>
<th>4 Unit maths</th>
<th>Equivalent HSC maths</th>
<th>chi square (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Year</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td></td>
</tr>
<tr>
<td>2nd Year</td>
<td>14</td>
<td>108</td>
<td>86</td>
<td>98</td>
<td>78</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>3rd Year</td>
<td>10</td>
<td>47</td>
<td>90</td>
<td>37</td>
<td>71</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>4th Year</td>
<td>3</td>
<td>58</td>
<td>97</td>
<td>54</td>
<td>90</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Students</td>
<td>10</td>
<td>325</td>
<td>90</td>
<td>290</td>
<td>80</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>Teachers</td>
<td>21</td>
<td>27</td>
<td>79</td>
<td>21</td>
<td>61</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

Among the student teachers, 80% studied 2 Unit mathematics, 8% studied 3 Unit mathematics and 1% studied 4 Unit mathematics while among the practising teachers in the sample, 61% studied 2 Unit mathematics, 9% studied 3 Unit mathematics.

The Chi Square tests revealed that there was no significant difference between the status of participants and their highest level of study of high school mathematics (chi square = 4.80, p = 0.187). In addition, there was no significant difference between the year level of students and the highest level of study of high school mathematics.

Table 4.18 provides a cross-tabulation of age group with the level of study in high school mathematics, here defined by the NSW syllabus as 2 Unit, 3 Unit and 4 Unit at Year 12 level and by an equivalent HSC mathematics in other countries. It outlines the number of students with Year 12 mathematics in each age group.
Table 4.18: Level of study of high school mathematics by age group

<table>
<thead>
<tr>
<th>Age</th>
<th>Year 10</th>
<th>HSC (Total)</th>
<th>2 Unit</th>
<th>3 Unit</th>
<th>4 Unit</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>17 – 24</td>
<td>4</td>
<td>2</td>
<td>275</td>
<td>98</td>
<td>250</td>
<td>90</td>
</tr>
<tr>
<td>25 – 34</td>
<td>15</td>
<td>34</td>
<td>29</td>
<td>67</td>
<td>22</td>
<td>50</td>
</tr>
<tr>
<td>35 – 44</td>
<td>14</td>
<td>42</td>
<td>19</td>
<td>58</td>
<td>18</td>
<td>55</td>
</tr>
<tr>
<td>45 – 54</td>
<td>3</td>
<td>60</td>
<td>2</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**chi square = 103.82, p = 0.0001**

The Chi Square test revealed that there was a significant difference between the age groups and the level of study of high school mathematics (chi square = 103.82, p = 0.0001). This result indicates that mature age students, in general, have studied significantly less mathematics than their younger counterparts and conform with the findings of Relich and Way (1996). It also emphasises the serious implications for this group as entrants into primary teacher education programs without the requisite background in mathematics as recommended in the *Discipline review of Teacher Education in Mathematics and Science* (1989).

4.3.2 Emphasis on mathematics in preservice program

The purpose of Question 3.1 in the questionnaires was to investigate the emphasis placed on teaching mathematics in the preservice teacher education program. This question compared the emphasis on mathematics with other Key Learning Areas (KLAs).
Table 4.19: Emphasis on mathematics in preservice program

<table>
<thead>
<tr>
<th></th>
<th>More than other KLAs</th>
<th>Same as other KLAs</th>
<th>Less than other KLAs</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;Year (N = 105)</td>
<td>7</td>
<td>7</td>
<td>88</td>
<td>84</td>
<td>10</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;Year (N = 124)</td>
<td>17</td>
<td>14</td>
<td>100</td>
<td>81</td>
<td>7</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;Year (N = 52)</td>
<td>5</td>
<td>10</td>
<td>37</td>
<td>71</td>
<td>10</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;Year (N = 59)</td>
<td>11</td>
<td>19</td>
<td>42</td>
<td>71</td>
<td>6</td>
</tr>
<tr>
<td>student teachers (N = 340)</td>
<td>40</td>
<td>12</td>
<td>267</td>
<td>79</td>
<td>33</td>
</tr>
<tr>
<td>Teachers (N = 33)</td>
<td>7</td>
<td>21</td>
<td>24</td>
<td>73</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4.19 provides the information regarding the emphasis on mathematics in preservice teacher education programs. It was found that 79% of the student teachers and 73% of the practising teachers were of the opinion that the emphasis on mathematics was same as on other KLAs. However, 21% of the practising teachers of this study perceived the emphasis on maths to be more than that on other KLAs while only 12% of the student teachers in the sample perceived more emphasis on mathematics. This is an indication of more perceived emphasis on maths in the past.

The Chi Square tests revealed that there was a significant difference (chi square = 13.49, p = 0.036) between the year level of the student teachers and their opinions about the emphasis on mathematics in their preservice teacher education program. Nineteen per cent of the 3<sup>rd</sup> year students reported that the emphasis on maths was less than other KLAs while 10% or less than 10% of
other year level students reported that the emphasis on maths was less than other KLAs. However, there was no significant difference (chi square = 2.69, p =0.261) between the status of participants and their opinions about the emphasis on mathematics in their preservice teacher education program.

Further, Question 3.2(a) asked whether the student teachers and practising teachers felt that they were/would be able to cope adequately with mathematics teaching in primary classrooms as a result of their training in the preservice program. Table 4.20 shows the information obtained in relation to this question.

<table>
<thead>
<tr>
<th></th>
<th>Better than other KLAs</th>
<th>Same as other KLAs</th>
<th>Worse than other KLAs</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1st Year (N = 111)</td>
<td>10</td>
<td>9</td>
<td>92</td>
<td>83</td>
<td>9</td>
</tr>
<tr>
<td>2nd Year (N = 122)</td>
<td>18</td>
<td>15</td>
<td>79</td>
<td>65</td>
<td>25</td>
</tr>
<tr>
<td>3rd Year (N = 52)</td>
<td>7</td>
<td>14</td>
<td>35</td>
<td>67</td>
<td>10</td>
</tr>
<tr>
<td>4th Year (N = 59)</td>
<td>12</td>
<td>20</td>
<td>38</td>
<td>64</td>
<td>9</td>
</tr>
<tr>
<td>Student Teachers</td>
<td>47</td>
<td>14</td>
<td>244</td>
<td>71</td>
<td>53</td>
</tr>
<tr>
<td>(N = 344)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>2</td>
<td>6</td>
<td>30</td>
<td>88</td>
<td>2</td>
</tr>
<tr>
<td>(N = 34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

71% of the student teachers and about 88% of the practising teachers believed that the preservice training had made them to cope with mathematics the same as with other KLAs in primary classrooms. Also about 65% of the student teachers in 2nd year, 3rd year and 4th year of study level in the sample perceived
the adequacy of mathematics training in the preservice was same as other KLAs while 83% of the 1st year student teachers of this study perceived the adequacy of mathematics training in preservice as same as other KLAs.

The Chi Square tests revealed that there was a significant difference (chi square = 13.51, p = 0.036) between the year levels of the student teachers in the sample and their perceptions about the preservice training program. More of the 1st year students (83%) perceived the adequacy of maths as same as with other KLAs because they had ‘Mathematics Education I’ as one of the core subjects while mathematics is an elective subject in other year levels. However, no any significant difference (chi square = 4.65, p = 0.098) was observed between the status of participants and their perception about the preservice training program.

Question 3.2(b) of the Teachers Questionnaire asked whether more compulsory time needed to be allotted to mathematics in their preservice teacher education program. Table 4.21 shows the responses received from each school.

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th></th>
<th>NO</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Sydney public</td>
<td>5</td>
<td>42</td>
<td>7</td>
<td>58</td>
</tr>
<tr>
<td>(N = 12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wollong. public</td>
<td>3</td>
<td>50</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>(N = 6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney indep.</td>
<td>3</td>
<td>50</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>(N = 6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woll. Catholic</td>
<td>3</td>
<td>43</td>
<td>4</td>
<td>57</td>
</tr>
<tr>
<td>(N = 7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (N =31)</td>
<td>14</td>
<td>45</td>
<td>17</td>
<td>55</td>
</tr>
</tbody>
</table>
Responses received from each school in this sample were in similar proportions and nearly half of them were of the opinion that inadequate time was being given to the study of mathematics and mathematics education in their preservice program. Some of the explanations offered by the teachers are given in Table 4.22.

Table 4.22: Teachers comments about the time allotted to mathematics

Question: Do you think more compulsory time needs to be allotted to mathematics in your preservice teacher program? Explain why.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes... Being numerate plays a major role in everyday life.</td>
</tr>
<tr>
<td>2</td>
<td>Yes... Constant changes in the syllabus need teachers to be competent and confident.</td>
</tr>
<tr>
<td>3</td>
<td>Yes... Teachers often lack confidence.</td>
</tr>
<tr>
<td>4</td>
<td>Yes... to ensure concepts are understood and ensure less reliance on a textbook</td>
</tr>
<tr>
<td>5</td>
<td>Yes... Teachers need to understand how children think and learn mathematically.</td>
</tr>
<tr>
<td>6</td>
<td>Yes... There are a lot of different areas of mathematics and different methods of getting the same result. It would be good to learn more than one.</td>
</tr>
<tr>
<td>7</td>
<td>Yes... Different techniques and teaching strategies should be investigated.</td>
</tr>
<tr>
<td>8</td>
<td>Yes... Group work can be challenging and students need to be able to handle different arrangements.</td>
</tr>
<tr>
<td>9</td>
<td>Yes... Kindy maths is very language based – most children in my class are ESL. Therefore not only have trouble learning maths concepts but the language of it.</td>
</tr>
<tr>
<td>10</td>
<td>No... All KLA’s are important and deserve the same amount of time allocated.</td>
</tr>
</tbody>
</table>

Teachers comments about the time allocation to mathematics in their preservice teacher education programs portray the importance of different concepts: mathematics in everyday life, mathematical competence and understanding, different techniques and teaching strategies, changes in the syllabus, importance of mathematical language.
4.4 Beliefs and Classroom Practice

Practising teachers and student teachers hold beliefs towards the nature and the teaching and learning of mathematics. These beliefs influence their teaching.

Both Teacher Questionnaire and Student Teacher Questionnaire included a number of questions to elicit the beliefs and conceptions of student teachers and practising teachers. In addition, the Teacher Questionnaire included questions on classroom practice. These questions covered the following areas:

- Nature of mathematics
- Mathematics curriculum in NSW
- Mathematics teaching and mathematics learning
- Resources for learning

Data obtained from the questionnaires was analysed in detail and discussed under these headings.

4.4.1 Nature of mathematics

It is important to find out the beliefs that student teachers hold towards the general nature of mathematics, before finding the beliefs about mathematics teaching and mathematics learning. Question 4.1 of both questionnaires asked about the beliefs on the nature of mathematics. This question consisted of five statements, which read:
'Mathematics should be seen as
(a) a practical way of coping with everyday life;
(b) a stepping stone to higher education;
(c) a precise discipline for training the mind;
(d) a powerful tool for solving problems;
(e) a creative activity.'

Each statement was followed by a Likert-type scale ranging from "strongly disagree" to "strongly agree". Each subject's response for each statement was given a value of 5, 4, 3, 2 or 1. A five represented a response of "strongly agree" and the numbers descended corresponding to the decreasing belief of the subject about the statement. Since the value of 3 indicates uncertainty about the belief on a statement, a mean above 3 is taken as agreement with a statement, and a mean below 3 is taken as disagreement with the statement. Table 4.23 shows how the student teachers (STs) and practising teachers (PTs) in the sample of this study responded to the five belief statements.

Table 4.23 reveals that both student teachers and practising teachers of this sample, on average, indicated an agreement with all five belief statements with a mean above 3 in every instance. It was also found that 95% or more of student teachers and practising teachers believed that 'Mathematics should be seen as a powerful tool for solving problems'.
<table>
<thead>
<tr>
<th>Belief statement</th>
<th>Subjects</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>maths ... as a practical way of coping with everyday life</td>
<td>STs (N = 361)</td>
<td>122 (34)</td>
<td>201 (56)</td>
<td>32 (9)</td>
<td>6 (2)</td>
<td>0</td>
<td>4.22</td>
<td>3.96</td>
<td>0.138</td>
</tr>
<tr>
<td></td>
<td>PTs (N = 34)</td>
<td>20 (59)</td>
<td>14 (41)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maths ... as a stepping stone to higher education</td>
<td>STs (N = 360)</td>
<td>67 (19)</td>
<td>206 (57)</td>
<td>61 (17)</td>
<td>23 (6)</td>
<td>3 (1)</td>
<td>3.86</td>
<td>1.88</td>
<td>0.433</td>
</tr>
<tr>
<td></td>
<td>PTs (N = 32)</td>
<td>5 (16)</td>
<td>16 (50)</td>
<td>8 (25)</td>
<td>3 (9)</td>
<td>0</td>
<td>3.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maths ... as a precise discipline for training the mind</td>
<td>STs (N = 359)</td>
<td>32 (9)</td>
<td>154 (43)</td>
<td>136 (38)</td>
<td>32 (9)</td>
<td>5 (1)</td>
<td>3.49</td>
<td>4.65</td>
<td>0.102</td>
</tr>
<tr>
<td></td>
<td>PTs (N = 32)</td>
<td>4 (13)</td>
<td>15 (47)</td>
<td>8 (25)</td>
<td>5 (16)</td>
<td>0</td>
<td>3.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maths ... as a powerful tool for solving problems</td>
<td>STs (N = 360)</td>
<td>142 (39)</td>
<td>200 (56)</td>
<td>14 (4)</td>
<td>3 (1)</td>
<td>1</td>
<td>4.33</td>
<td>0.44</td>
<td>0.804</td>
</tr>
<tr>
<td></td>
<td>PTs (N = 33)</td>
<td>16 (48)</td>
<td>16 (48)</td>
<td>1 (3)</td>
<td>0</td>
<td>0</td>
<td>4.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maths ... as a creative activity</td>
<td>STs (N = 360)</td>
<td>47 (13)</td>
<td>155 (43)</td>
<td>87 (24)</td>
<td>54 (15)</td>
<td>17 (5)</td>
<td>3.45</td>
<td>6.39**</td>
<td>0.041</td>
</tr>
<tr>
<td></td>
<td>PTs (N = 33)</td>
<td>4 (12)</td>
<td>22 (67)</td>
<td>4 (12)</td>
<td>3 (9)</td>
<td>0</td>
<td>3.82</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Responses: SA (strongly agree), A (agree), U (uncertain), D (disagree) & SD (strongly disagree)

** Significant at the 0.05 level. The Chi Squares compared the distribution of response of the two categories (STs and PTs) for each statement.
For a Chi Square analysis, a 'rule-of-thumb' recommended by Burns (2000) is adopted to make the sample statistics to approximate the theoretical Chi Square distribution very closely. In order to make the expected frequencies in as many cells to be equal to or greater than 5, responses marked “SD” (strongly disagree) and “D” (agree) are collapsed into the “disagree” group, while responses marked “A” (agree) and “SA” (strongly agree) are collapsed into the “agree” group. Also, by combining data in this manner, the magnitude of the differences between degrees of agreement and disagreement is somewhat reduced.

The Chi Square tests revealed that there was a statistically significant difference (chi square = 6.39, p = 0.041) in the beliefs of the student teachers and practising teachers about the statement that ‘Mathematics should be seen as a creative activity’, 79% of the practising teachers in the sample of this study agreed with the statement while only 56% of the student teachers agreed with it. No significant difference was found in the beliefs of student teachers and practising teachers about the other statements.

Furthermore, Descriptive Statistics and Chi Square Statistics were used to identify any differences by student year level and school type. Mean values of the responses were calculated in the same manner as stated before by assigning values 1,2,3,4 and 5 to the responses “strongly disagree” (SD), “disagree” (D), “uncertain” (U), “agree” (A) and “strongly agree” (SA) respectively. Chi Squares were calculated by combining responses marked “SD” and “D” into “disagree” group and responses marked “SA” and “A” into agree group, to make the expected frequencies in as many cells to be equal to or greater than 5.
Table 4.24: Distribution of Student Teacher Responses at different Year Levels

<table>
<thead>
<tr>
<th>Belief Statement</th>
<th>Year Level of STs (N)</th>
<th>Agree (%)</th>
<th>Uncertain (%)</th>
<th>Disagree (%)</th>
<th>Mean</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.(a) Maths as a practical way of coping with every day life</td>
<td>1st Yr. (125)</td>
<td>114 (91)</td>
<td>8 (6)</td>
<td>3 (2)</td>
<td>4.18</td>
<td>9.77</td>
<td>0.135</td>
</tr>
<tr>
<td></td>
<td>2nd Yr. (124)</td>
<td>105 (85)</td>
<td>18 (14)</td>
<td>1 (1)</td>
<td>4.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Yr. (52)</td>
<td>50 (96)</td>
<td>1 (2)</td>
<td>1 (2)</td>
<td>4.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Yr. (60)</td>
<td>54 (90)</td>
<td>5 (8)</td>
<td>1 (2)</td>
<td>4.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.(b) Maths as a stepping stone to higher education</td>
<td>1st Yr. (125)</td>
<td>96 (76)</td>
<td>22 (18)</td>
<td>7 (6)</td>
<td>3.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Yr. (124)</td>
<td>95 (76)</td>
<td>22 (18)</td>
<td>7 (6)</td>
<td>3.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Yr. (51)</td>
<td>34 (67)</td>
<td>12 (23)</td>
<td>5 (10)</td>
<td>3.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Yr. (60)</td>
<td>46 (76)</td>
<td>7 (12)</td>
<td>7 (12)</td>
<td>3.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.(c) Maths as a precise discipline for training the mind</td>
<td>1st Yr. (125)</td>
<td>66 (53)</td>
<td>46 (37)</td>
<td>13 (10)</td>
<td>3.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Yr. (124)</td>
<td>73 (59)</td>
<td>44 (35)</td>
<td>7 (6)</td>
<td>3.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Yr. (50)</td>
<td>18 (36)</td>
<td>25 (50)</td>
<td>7 (14)</td>
<td>3.28</td>
<td>11.70</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>4th Yr. (60)</td>
<td>29 (48)</td>
<td>21 (35)</td>
<td>10 (17)</td>
<td>3.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.(d) Maths as a powerful tool for solving problem</td>
<td>1st Yr. (125)</td>
<td>117 (93)</td>
<td>6 (5)</td>
<td>2 (2)</td>
<td>4.26</td>
<td>4.73</td>
<td>0.579</td>
</tr>
<tr>
<td></td>
<td>2nd Yr. (124)</td>
<td>118 (95)</td>
<td>5 (4)</td>
<td>1 (1)</td>
<td>4.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Yr. (52)</td>
<td>47 (92)</td>
<td>3 (6)</td>
<td>2 (3)</td>
<td>4.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Yr. (60)</td>
<td>60 (100)</td>
<td>-</td>
<td>-</td>
<td>4.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.(e) Maths as a creative activity</td>
<td>1st Yr. (125)</td>
<td>62 (50)</td>
<td>28 (22)</td>
<td>35 (28)</td>
<td>3.24</td>
<td>23.51</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>2nd Yr. (124)</td>
<td>61 (49)</td>
<td>43 (35)</td>
<td>20 (16)</td>
<td>3.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Yr. (51)</td>
<td>36 (70)</td>
<td>8 (16)</td>
<td>7 (14)</td>
<td>3.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Yr. (60)</td>
<td>43 (72)</td>
<td>8 (13)</td>
<td>9 (15)</td>
<td>3.70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.24 provides mean values calculated for the responses on each belief statement and the chi square values calculated for the distribution of responses of the four student teachers groups across the five belief statements. All four cohorts of student teachers displayed an agreement with every belief statement with a mean above 3 in every instance. Two-thirds or more of the participants from each year level group agreed with the statement that 'Mathematics should be seen as a stepping stone to higher education.'
In addition, it was found that the order of strength among the five belief statements was the same with 1st year, 2nd year and 4th year student groups. This order of strength was ‘Mathematics as a powerful tool for solving problems’, ‘mathematics as a practical way of coping with everyday life’, ‘mathematics as a stepping stone to higher education’, ‘mathematics as a precise discipline for training the mind’ and ‘mathematics as a creative activity’. 3rd year students group had a stronger agreement with ‘mathematics as a practical way of coping with everyday life’ than ‘mathematics as a powerful tool for solving problems’.

Chi Square analysis revealed that there was a statistically significant difference (chi square = 23.51, p = 0.0006) in the beliefs of the student groups about the statement that ‘Mathematics should be seen as a creative activity’. 70% or more of the student teachers in 3rd year and 4th year levels of study in the sample of this study agreed with this statement while only about 50% of the student teachers in 1st year and 2nd year agreed with the same. This shows that the student teachers changed their opinion more strongly over the course in relation to the statement that ‘Mathematics should be seen as a creative activity’. Further, no more significant difference was found in the beliefs about the other statements.

Although there was no more significant difference between the beliefs of the four student groups across the other four belief statements on the nature of mathematics, some interesting findings were observed which gave the general picture of the participants’ beliefs. All fourth year students in this sample were in agreement with the belief statement that 'Mathematics should be seen as a powerful tool for solving problems', while 92% or more of other year level student groups in this sample agreed with the same. In a similar manner, 85%
or more of the student teachers from each year level group believed that ‘Mathematics should be seen as a practical way of coping with everyday life’.

4.4.2 Mathematics Curriculum in NSW

Teachers’ conceptions of mathematics curriculum are important as they have an effect on classroom practice in mathematics education. Attitudes and knowledge of teachers about the curriculum help in implementing any reform in education. In view of this a set of belief statements were put forward.

“Question 5” of the Student Questionnaire and “Question 8” of the Teacher Questionnaire were the same and asked about the mathematics curriculum in NSW. This question consisted of ten belief statements:

a Too much emphasis is placed on mathematics in the NSW primary curriculum;

b The learning of tables in primary classes is essential;

c Children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts;

d Too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics;

e Problem solving instruction should emphasis the process of problem solving more than on the product;

f Problem solving should be taught as a collection of smaller component skills;
g The school should provide parents with enough information about what children are being taught.

h The school should try to explain to parents some of the modern strategies used nowadays;

i The teacher should give tests to the children at least every week;

j State-wide Basic Skills Tests are essential to monitor the children's progress.

Participants were asked to respond to each of these statements by indicating the degree to which they agreed or disagreed with the statement on a Likert-type ranging from "strongly disagree" to "strongly agree". As before, each subject's response for each statement was given a value of 1, 2, 3, 4 or 5. A "five" represented a response of "strongly agree" and the numbers descended corresponding to the decreasing belief of the subject about the statement.

Since the value of "three" represents uncertainty about the belief on a statement, a mean above 3 is taken as agreement with a statement and a mean below 3 is taken as disagreement with the statement.

Table 4.25 shows how the student teachers (STs) and practising teachers (PTs) responded to the ten belief statements.

While there was a diversity of views within each group, an analysis of the data presented in Table 4.25 shows that both student teachers and practising teachers in the sample of this study, on average, agreed with seven belief statements and disagreed with three belief statements. They believed that 'the school should provide parents with enough information about what children are being taught', 'the learning of tables in primary classes is essential', 'the school should try to explain to parents some of the modern strategies used nowadays',
<table>
<thead>
<tr>
<th>Belief Statement (item)</th>
<th>STs (N)</th>
<th>SA (%)</th>
<th>A (%)</th>
<th>U (%)</th>
<th>D (%)</th>
<th>SD (%)</th>
<th>Mean</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Too much emphasis is placed on mathematics...</td>
<td>STs (360)</td>
<td>3 (1)</td>
<td>30 (8)</td>
<td>106 (30)</td>
<td>188 (52)</td>
<td>33 (9)</td>
<td>2.39</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>0</td>
<td>2 (6)</td>
<td>3 (9)</td>
<td>22 (65)</td>
<td>7 (21)</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>(b) The learning of tables in primary classes is essential.</td>
<td>STs (360)</td>
<td>142 (39)</td>
<td>180 (50)</td>
<td>26 (7)</td>
<td>10 (3)</td>
<td>2 (1)</td>
<td>4.25</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>16 (47)</td>
<td>14 (41)</td>
<td>3 (9)</td>
<td>1 (3)</td>
<td>0</td>
<td>4.32</td>
<td>2</td>
</tr>
<tr>
<td>(c) Children who use calculators too early will not acquire fluency...</td>
<td>STs (360)</td>
<td>90 (25)</td>
<td>173 (48)</td>
<td>60 (17)</td>
<td>34 (9)</td>
<td>3 (1)</td>
<td>3.87</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>6 (18)</td>
<td>8 (24)</td>
<td>7 (21)</td>
<td>12 (35)</td>
<td>1 (3)</td>
<td>3.18</td>
<td>6</td>
</tr>
<tr>
<td>(d) Too much attention is given to developing computational ability...</td>
<td>STs (358)</td>
<td>26 (7)</td>
<td>106 (30)</td>
<td>181 (51)</td>
<td>43 (12)</td>
<td>2 (1)</td>
<td>3.31</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>PTs (33)</td>
<td>4 (12)</td>
<td>8 (24)</td>
<td>10 (30)</td>
<td>10 (30)</td>
<td>1 (3)</td>
<td>3.12</td>
<td>7</td>
</tr>
<tr>
<td>(e) Problem solving instruction should emphasise the process...</td>
<td>STs (358)</td>
<td>92 (26)</td>
<td>182 (51)</td>
<td>73 (20)</td>
<td>11 (3)</td>
<td>0</td>
<td>3.99</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>8 (25)</td>
<td>20 (63)</td>
<td>3 (9)</td>
<td>1 (3)</td>
<td>0</td>
<td>4.09</td>
<td>4</td>
</tr>
<tr>
<td>(f) Problem solving should be taught as a collection of...</td>
<td>STs (357)</td>
<td>50 (14)</td>
<td>205 (57)</td>
<td>90 (25)</td>
<td>12 (3)</td>
<td>0</td>
<td>3.82</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>PTs (31)</td>
<td>7 (23)</td>
<td>20 (65)</td>
<td>2 (6)</td>
<td>2 (6)</td>
<td>0</td>
<td>4.03</td>
<td>6</td>
</tr>
<tr>
<td>(g) The school should provide parents with enough information...</td>
<td>STs (357)</td>
<td>154 (43)</td>
<td>185 (52)</td>
<td>15 (4)</td>
<td>3 (1)</td>
<td>0</td>
<td>4.37</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>11 (34)</td>
<td>17 (53)</td>
<td>1 (3)</td>
<td>3 (9)</td>
<td>0</td>
<td>4.12</td>
<td>3</td>
</tr>
<tr>
<td>(h) The school should try to explain to parents some of...</td>
<td>STs (357)</td>
<td>138 (39)</td>
<td>177 (50)</td>
<td>32 (9)</td>
<td>7 (2)</td>
<td>3 (3)</td>
<td>4.23</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>13 (41)</td>
<td>16 (50)</td>
<td>1 (3)</td>
<td>2 (6)</td>
<td>0</td>
<td>4.25</td>
<td>3</td>
</tr>
<tr>
<td>(i) The teacher should give tests... at least every week.</td>
<td>STs (358)</td>
<td>16 (4)</td>
<td>62 (17)</td>
<td>106 (30)</td>
<td>150 (42)</td>
<td>24 (7)</td>
<td>2.71</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>2 (6)</td>
<td>4 (13)</td>
<td>2 (6)</td>
<td>18 (56)</td>
<td>6 (19)</td>
<td>2.31</td>
<td>9</td>
</tr>
<tr>
<td>(j) State-wide Basic Skills Tests are essential to monitor...</td>
<td>STs (355)</td>
<td>19 (5)</td>
<td>93 (26)</td>
<td>123 (35)</td>
<td>86 (24)</td>
<td>34 (10)</td>
<td>2.94</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>0</td>
<td>9 (28)</td>
<td>7 (22)</td>
<td>9 (28)</td>
<td>7 (22)</td>
<td>2.56</td>
<td>8</td>
</tr>
</tbody>
</table>
‘problem solving instruction should emphasise the process of problem solving more than on the product’, ‘children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts’, ‘problem solving should be taught as a collection of smaller component skills’, and ‘too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics’. On the other hand, both student teachers and practising teachers disagreed with the belief statements ‘State-wide Basic Skills Tests are essential to monitor the children’s progress’, ‘The teacher should give tests to the children at least every week’ and ‘Too much emphasis is placed on mathematics in the NSW primary curriculum’.

The highest level of agreement was shown on the belief statement that ‘the school should provide parents with enough information about what children are being taught.’ This reflects awareness of the accountability of the school in relation to children’s education.

Before doing a Chi Square analysis, responses marked "SD" (strongly disagree) and "D" (disagree) are collapsed into the “disagree” group, while responses marked “A” (agree) and “SA” (strongly agree” are collapsed into the “agree” group in order to make the expected frequencies in as many cells to be equal or greater than 5, as recommended by Burns (2000).

Table 4.26 provides a summary of significant Chi Square analysis for status of participants on the belief statements about the curriculum in NSW.
Table 4.26: Summary of Significant Chi Square Analysis for Status of Participants on the Belief Statements about the Curriculum in NSW

<table>
<thead>
<tr>
<th>Belief Statement</th>
<th>Status of participant</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Chi Square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>5c Children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts.</td>
<td>Student Teachers</td>
<td>263</td>
<td>60 (61.2)</td>
<td>37 (45.7)</td>
<td>23.91</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Practising Teachers</td>
<td>14</td>
<td>7 (5.8)</td>
<td>13 (4.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5g The school should provide parents with enough information about what children are being taught.</td>
<td>Student Teachers</td>
<td>339</td>
<td>15 (14.7)</td>
<td>3 (5.5)</td>
<td>14.12</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Practising Teachers</td>
<td>28</td>
<td>1 (1.3)</td>
<td>3 (0.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5d Too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics</td>
<td>Student Teachers</td>
<td>132</td>
<td>181 (174.9)</td>
<td>45 (51.3)</td>
<td>11.64</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Practising Teachers</td>
<td>12</td>
<td>10 (16.1)</td>
<td>11 (4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5i The teacher should give tests to the children at least every week.</td>
<td>Student Teachers</td>
<td>78</td>
<td>106 (99.1)</td>
<td>174 (181.8)</td>
<td>9.95</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>Practising Teachers</td>
<td>6</td>
<td>2 (8.9)</td>
<td>24 (16.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5a Too much emphasis is placed on mathematics in the NSW primary curriculum.</td>
<td>Student Teachers</td>
<td>33</td>
<td>106 (99.6)</td>
<td>221 (228.4)</td>
<td>7.95</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>Practising Teachers</td>
<td>2</td>
<td>3 (9.4)</td>
<td>29 (21.6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Expected frequencies are given in parentheses.
Table 4.26 shows that the level of agreement was significantly greater among student teachers on the belief statement about the use of calculators (Statement 5c). Also, it was found that 73% of the student teachers agreed that children who use calculators too early would not acquire fluency in computation nor confident recall of basic number facts while only 42% of the practising teachers agreed on this statement.

The second greatest difference between the belief of PTs and STs in the sample of this study was on belief statement 5g. Practising teachers' level of agreement on the need for parents to be provided with information about what their children were being taught was significantly lower than that of the student teachers.

There was also a significant difference between student teachers and practising teachers in the level of agreement on the belief statement about the attention given to developing computational ability (Statement 5d). More student teachers (51%) than expected were uncertain about the statement and more practising teachers (33%) than expected were in disagreement that “too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics”.

Furthermore, there was a significant difference between the student teachers and practising teachers in the level of agreement on the belief statement (Item 5i) about giving test to the children (chi square = 9.95, p = 0.007).

Finally, the student teachers and practising teachers differed significantly in their perceptions on the belief statement (Statement 5a) about the emphasis on mathematics in NSW curriculum (chi square = 7.95, p = 0.019).
Table 4.27 illustrates how the student teachers at different year levels responded to the ten belief statements. Student teachers from all four year levels strongly believed that 'the school should provide parents with enough information about what children are being taught', the learning of tables in primary classes is essential' and ‘the school should try to explain to parents some of the modern strategies used nowadays’. They also strongly believed that 'problem solving instruction should emphasis the process of problem solving more than on the product' and ‘children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts’.

Chi Square analysis was carried out after collapsing the responses marked “SA” and “A” into “agree” group while “D” and “SD” collapsed into “disagree” group. A summary of significant Chi Square analysis is presented in Table 4.28.
## Table 4.27: Student Teachers' Responses to 10 Belief Statements about NSW Primary Curriculum

<table>
<thead>
<tr>
<th>Belief Statement</th>
<th>Subject (N)</th>
<th>SA (%)</th>
<th>A (%)</th>
<th>U (%)</th>
<th>D (%)</th>
<th>SD (%)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (124)</td>
<td>2 (2)</td>
<td>7 (6)</td>
<td>49 (40)</td>
<td>52 (42)</td>
<td>14 (11)</td>
<td>2.44</td>
</tr>
<tr>
<td>5a Too much emphasis is placed on mathematics in the NSW primary curriculum.</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>1 (1)</td>
<td>17 (14)</td>
<td>34 (27)</td>
<td>64 (52)</td>
<td>8 (6)</td>
<td>2.51</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>0</td>
<td>3 (6)</td>
<td>14 (27)</td>
<td>31 (60)</td>
<td>4 (8)</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>0</td>
<td>3 (5)</td>
<td>9 (15)</td>
<td>41 (68)</td>
<td>7 (12)</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (124)</td>
<td>55 (44)</td>
<td>60 (48)</td>
<td>4 (3)</td>
<td>3 (2)</td>
<td>2 (2)</td>
<td>4.31</td>
</tr>
<tr>
<td>5b The learning of tables in primary classes is essential</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>46 (37)</td>
<td>64 (52)</td>
<td>12 (10)</td>
<td>2 (2)</td>
<td>0</td>
<td>4.24</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>17 (33)</td>
<td>26 (50)</td>
<td>7 (13)</td>
<td>2 (4)</td>
<td>0</td>
<td>4.11</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>24 (40)</td>
<td>30 (50)</td>
<td>3 (5)</td>
<td>3 (5)</td>
<td>0</td>
<td>4.25</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (124)</td>
<td>34 (27)</td>
<td>71 (57)</td>
<td>13 (10)</td>
<td>5 (4)</td>
<td>1 (1)</td>
<td>4.06</td>
</tr>
<tr>
<td>5c Children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts.</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>31 (25)</td>
<td>55 (44)</td>
<td>24 (19)</td>
<td>12 (10)</td>
<td>2 (2)</td>
<td>3.81</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>9 (17)</td>
<td>23 (44)</td>
<td>10 (19)</td>
<td>10 (19)</td>
<td>0</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>16 (27)</td>
<td>24 (40)</td>
<td>13 (22)</td>
<td>7 (12)</td>
<td>0</td>
<td>3.82</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (122)</td>
<td>10 (8)</td>
<td>39 (32)</td>
<td>59 (48)</td>
<td>13 (11)</td>
<td>1 (1)</td>
<td>3.36</td>
</tr>
<tr>
<td>5d Too much attention is given to developing computational ability at the expense of the development of those understandings ...</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>8 (6)</td>
<td>35 (28)</td>
<td>68 (55)</td>
<td>12 (10)</td>
<td>1 (1)</td>
<td>3.29</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>4 (8)</td>
<td>11 (21)</td>
<td>24 (46)</td>
<td>13 (25)</td>
<td>0</td>
<td>3.11</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>4 (7)</td>
<td>21 (35)</td>
<td>30 (50)</td>
<td>5 (8)</td>
<td>0</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (123)</td>
<td>27 (22)</td>
<td>65 (53)</td>
<td>27 (22)</td>
<td>4 (3)</td>
<td>0</td>
<td>3.93</td>
</tr>
<tr>
<td>5e Problem solving instruction should emphasise the process of problem solving more than on the product.</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>22 (18)</td>
<td>63 (51)</td>
<td>36 (29)</td>
<td>3 (2)</td>
<td>0</td>
<td>3.84</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>21 (40)</td>
<td>24 (46)</td>
<td>4 (8)</td>
<td>3 (6)</td>
<td>0</td>
<td>4.21</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (59)</td>
<td>22 (37)</td>
<td>30 (51)</td>
<td>6 (10)</td>
<td>1 (2)</td>
<td>0</td>
<td>4.24</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (122)</td>
<td>18 (15)</td>
<td>68 (56)</td>
<td>31 (25)</td>
<td>5 (4)</td>
<td>0</td>
<td>3.81</td>
</tr>
<tr>
<td>5f Problem solving should be taught as a collection of smaller component skills.</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>17 (14)</td>
<td>71 (57)</td>
<td>31 (25)</td>
<td>5 (4)</td>
<td>0</td>
<td>3.81</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>8 (15)</td>
<td>30 (58)</td>
<td>13 (25)</td>
<td>1 (2)</td>
<td>0</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (59)</td>
<td>7 (12)</td>
<td>36 (61)</td>
<td>15 (25)</td>
<td>1 (2)</td>
<td>0</td>
<td>3.83</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (122)</td>
<td>54 (44)</td>
<td>62 (51)</td>
<td>6 (5)</td>
<td>0</td>
<td>0</td>
<td>4.39</td>
</tr>
<tr>
<td>5g The school should provide parents with enough information about what children are being taught.</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>52 (42)</td>
<td>66 (53)</td>
<td>3 (2)</td>
<td>3 (2)</td>
<td>0</td>
<td>4.35</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>22 (42)</td>
<td>28 (54)</td>
<td>2 (4)</td>
<td>0</td>
<td>0</td>
<td>4.38</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (59)</td>
<td>26 (44)</td>
<td>29 (49)</td>
<td>4 (7)</td>
<td>0</td>
<td>0</td>
<td>4.27</td>
</tr>
<tr>
<td>Belief Statement</td>
<td>Subject (N)</td>
<td>SA (%)</td>
<td>A (%)</td>
<td>U (%)</td>
<td>D (%)</td>
<td>SD (%)</td>
<td>Mean</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>5h The school should try to explain to parents some of the modern strategies used nowadays.</td>
<td>1st Year(122)</td>
<td>45 (37)</td>
<td>59 (48)</td>
<td>14 (11)</td>
<td>3 (2)</td>
<td>1 (1)</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>2nd Year(124)</td>
<td>45 (36)</td>
<td>63 (51)</td>
<td>13 (10)</td>
<td>3 (2)</td>
<td>0 (0)</td>
<td>4.21</td>
</tr>
<tr>
<td></td>
<td>3rd Year (52)</td>
<td>27 (52)</td>
<td>23 (44)</td>
<td>2 (4)</td>
<td>0 (0)</td>
<td>2 (3)</td>
<td>4.48</td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>21 (36)</td>
<td>32 (54)</td>
<td>3 (5)</td>
<td>1 (2)</td>
<td>0 (0)</td>
<td>4.17</td>
</tr>
<tr>
<td>5i The teacher should give tests to the children at least every week.</td>
<td>1st Year(123)</td>
<td>7 (6)</td>
<td>31 (25)</td>
<td>42 (34)</td>
<td>37 (30)</td>
<td>6 (5)</td>
<td>2.97</td>
</tr>
<tr>
<td></td>
<td>2nd Year(124)</td>
<td>5 (4)</td>
<td>21 (17)</td>
<td>45 (36)</td>
<td>49 (40)</td>
<td>4 (3)</td>
<td>2.97</td>
</tr>
<tr>
<td></td>
<td>3rd Year (52)</td>
<td>1 (2)</td>
<td>2 (4)</td>
<td>9 (17)</td>
<td>30 (58)</td>
<td>10 (19)</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>3 (5)</td>
<td>8 (14)</td>
<td>10 (17)</td>
<td>34 (58)</td>
<td>4 (7)</td>
<td>2.53</td>
</tr>
<tr>
<td>5j State-wide Basic Skills Tests are essential to monitor the children's progress.</td>
<td>1st Year(121)</td>
<td>9 (7)</td>
<td>39 (32)</td>
<td>44 (36)</td>
<td>24 (20)</td>
<td>5 (4)</td>
<td>3.19</td>
</tr>
<tr>
<td></td>
<td>2nd Year(124)</td>
<td>6 (5)</td>
<td>37 (30)</td>
<td>47 (38)</td>
<td>27 (22)</td>
<td>7 (6)</td>
<td>3.06</td>
</tr>
<tr>
<td></td>
<td>3rd Year (52)</td>
<td>1 (2)</td>
<td>5 (10)</td>
<td>12 (23)</td>
<td>21 (40)</td>
<td>13 (25)</td>
<td>2.23</td>
</tr>
<tr>
<td></td>
<td>4th Year (58)</td>
<td>3 (5)</td>
<td>12 (21)</td>
<td>20 (34)</td>
<td>14 (24)</td>
<td>9 (16)</td>
<td>2.76</td>
</tr>
</tbody>
</table>

Table 4.28: Summary of significant Chi Square Analysis for different Year Levels of Student Teachers on the belief statements about the curriculum in NSW

<table>
<thead>
<tr>
<th>Belief Statement</th>
<th>Year Level</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>5i The teacher should give tests to the children at least every week.</td>
<td>1st Year</td>
<td>38(26.8)**</td>
<td>42 (36.4)</td>
<td>43 (59.8)</td>
<td>36.89</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>2nd Year</td>
<td>26 (27.0)</td>
<td>45 (36.7)</td>
<td>53 (60.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year</td>
<td>3 (11.3)</td>
<td>9 (15.4)</td>
<td>40 (25.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Year</td>
<td>11 (12.9)</td>
<td>10 (17.5)</td>
<td>38 (28.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5j State-wide Basic Skills Tests are essential to monitor the children's progress.</td>
<td>1st Year</td>
<td>48 (38.1)</td>
<td>44 (41.8)</td>
<td>29 (41.2)</td>
<td>34.82</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>2nd Year</td>
<td>43 (39.0)</td>
<td>47 (42.8)</td>
<td>34 (42.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year</td>
<td>6 (16.7)</td>
<td>12 (18.3)</td>
<td>35 (18.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Year</td>
<td>15 (18.3)</td>
<td>20 (20.0)</td>
<td>23 (19.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5a Too much emphasis is placed on mathematics in the NSW primary curriculum.</td>
<td>1st Year</td>
<td>9 (11.4)</td>
<td>49 (36.5)</td>
<td>66 (76.1)</td>
<td>20.21</td>
<td>0.0025</td>
</tr>
<tr>
<td></td>
<td>2nd Year</td>
<td>18 (11.4)</td>
<td>34 (36.5)</td>
<td>72 (76.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year</td>
<td>3 (4.8)</td>
<td>14 (15.3)</td>
<td>35 (31.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Year</td>
<td>3 (5.5)</td>
<td>9 (17.7)</td>
<td>48 (36.8)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There was a highly significant difference (chi square = 34.82, p = 0.0001) between the responses of the student teachers on the belief statement about weekly tests (Statement 5i). Student teachers later in their course were significantly less likely to agree with the statement that “the teacher should give tests to the children at least every week”. During the program, they seem to believe less in the importance of weekly mathematics tests. More 3rd Year and 4th Year student teachers than expected disagreed on the belief statement while fewer 1st Year and 2nd Year student teachers than expected disagreed on the belief statement. Although there was a significant difference, on average, Table 4.27 shows that student teachers at all year levels disagreed with the statement.

The second most significant difference between the belief statements of the student teachers across different year levels was on the statement (item 5j) about the essentiality of “state-wide Basic Skills Test” (chi square = 34.82, p =
0.0001). It was found that the student teachers in 3rd year and 4th year of study were less likely to believe that ‘the state-wide Basic Skills Tests are essential to monitor children’s progress’. On average, 1st and 2nd year student teachers agreed while 3rd and 4th Year student teachers disagreed.

Further, student teachers’ level of agreement was seen to vary significantly across different year levels on the belief statement that ‘too much emphasis is placed on mathematics in the NSW primary curriculum’ (chi square = 20.21, p = 0.0025). 3rd year and 4th year student teachers were less likely to believe that ‘too much emphasis is placed in the NSW curriculum’ than 1st year and 2nd year student teachers. However, on average, student teachers of all year levels disagreed on that the emphasis was too much for mathematics in NSW primary curriculum (mean: 1st year = 2.44, 2nd Year = 2.51, 3rd Year = 2.31, 4th Year = 2.13).

Also, Chi Square analysis revealed that there was a significant difference between the belief statements of student teachers across different year levels on the belief statement (item 5e) about the emphasis on problem solving (chi square = 16.40, p = 0.012). More student teachers from 3rd year and 4th year (86% & 87% respectively) than the student teachers from 1st year and 2nd year (75% & 69% respectively) agreed with that ‘Problem solving instruction should emphasis the process of problem solving more than on the product’. In addition, 1st year and 2nd year student teachers agreed with this statement (mean: 1st year = 3.93, 2nd year = 3.84) while 3rd year and 4th year student teachers strongly agreed with the same (mean: 3rd year = 4.21, 4th year = 4.24). However, student teachers, on average, believed that ‘too much attention was given to developing computational ability’. 
Finally, a significant difference was also revealed between the belief statements of student teachers across different year levels on the statement (item5c) about the use of calculators (chi square = 16.15, p = 0.013). 1st year student teachers' beliefs were the strongest among the four year level students on that 'children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts'. However, all year levels, on average, were in agreement with the statement (mean: 1st Year = 4.06, 2nd Year = 3.81, 3rd Year = 3.60, 4th Year = 3.82).

All these analyses show that the student teachers differ in how they answered the belief statements according to their year level of study. As the first year student teachers were at their beginning of their course of study, they differed in their statements with other year level students. This difference was significant only on a limited number of beliefs and the differences overall were not large. This shows that there was only a little systematic change over the course.

4.4.3 Mathematics Teaching Strategies

The kinds of teaching strategies teachers use play a key role in mathematics teaching and mathematics learning. Suitability of a particular strategy may depend on the background of students, the learning objectives and the subject matter.

Question 4.2 of both Teacher Questionnaire and Student Teacher Questionnaire asked about the teaching strategies they used or they would use. Eight strategies were listed and the subjects were requested to note down on a Likert-type scale how often they used or they would use each of the strategies.
The responses ranged from ‘never’ to ‘very often’. Each of these responses (‘never’, ‘seldom’, ‘sometimes’, ‘often’ and ‘very often’) was assigned a value of 1, 2, 3, 4 and 5 respectively and the mean value was calculated for each strategy. Table 4.29 provides an account of the frequency distribution of the responses.

Practising teachers and student teachers in this study were found to have similar levels of preference for different teaching strategies in mathematics. For example, both of them noted ‘hands-on experience’ as the most used or intended teaching strategy. This is indicated by the highest mean values (for student teachers: mean = 4.45 & for practising teachers: mean = 4.41).

Despite small differences in the mean values both practising teachers and student teachers in this sample ‘often’ used or intended to ‘often’ use the following teaching strategies: hands-on experience, co-operative learning, problem solving, resource-based learning, guided discovery, drill and practice, and regular written tests (see Table 4.29).

The mean values for their practice of using or intention to use ‘journal writing’ were below the value ‘three’ (mean for student teachers = 2.71 & mean for practising teachers = 2.32). This shows that they ‘seldom’ used or intended to use ‘journal writing’ as a teaching strategy in mathematics teaching.
Table 4.29: Distribution of frequencies for the use of different teaching strategies

<table>
<thead>
<tr>
<th>Teaching Strategy</th>
<th>Participants (N)</th>
<th>Never (%)</th>
<th>Seldom (%)</th>
<th>Sometimes (%)</th>
<th>Often (%)</th>
<th>Very often (%)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2a Drill &amp; Practice</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (11)</td>
<td>3 (3)</td>
<td>26 (23)</td>
<td>33 (29)</td>
<td>42 (37)</td>
<td>11 (10)</td>
<td>3.28</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>-</td>
<td>10 (8)</td>
<td>47 (38)</td>
<td>59 (48)</td>
<td>8 (6)</td>
<td>3.52</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>-</td>
<td>4 (8)</td>
<td>29 (56)</td>
<td>14 (27)</td>
<td>5 (10)</td>
<td>3.38</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>-</td>
<td>5 (8)</td>
<td>27 (45)</td>
<td>23 (38)</td>
<td>5 (8)</td>
<td>3.47</td>
</tr>
<tr>
<td></td>
<td>STs (351)</td>
<td>3 (1)</td>
<td>45 (13)</td>
<td>136 (39)</td>
<td>138 (39)</td>
<td>29 (8)</td>
<td>3.41</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>1 (3)</td>
<td>14 (41)</td>
<td>12 (35)</td>
<td>3 (9)</td>
<td></td>
<td>3.35</td>
</tr>
<tr>
<td>4.2b Problem solving</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (120)</td>
<td>-</td>
<td>3 (3)</td>
<td>10 (8)</td>
<td>70 (58)</td>
<td>37 (31)</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>16 (13)</td>
<td>75 (60)</td>
<td>31 (25)</td>
<td>4.08</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>-</td>
<td></td>
<td>5 (10)</td>
<td>29 (56)</td>
<td>18 (35)</td>
<td>4.25</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>-</td>
<td>1 (2)</td>
<td>5 (8)</td>
<td>41 (68)</td>
<td>13 (22)</td>
<td>4.10</td>
</tr>
<tr>
<td></td>
<td>STs (356)</td>
<td>1 (-)</td>
<td>36 (10)</td>
<td>215 (60)</td>
<td>99 (28)</td>
<td></td>
<td>4.14</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>-</td>
<td>9 (26)</td>
<td>18 (53)</td>
<td>7 (21)</td>
<td></td>
<td>3.94</td>
</tr>
<tr>
<td>4.2c Hands-on experiences</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (117)</td>
<td>-</td>
<td>2 (2)</td>
<td>14 (12)</td>
<td>39 (33)</td>
<td>62 (53)</td>
<td>4.38</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>-</td>
<td>-</td>
<td>7 (6)</td>
<td>57 (46)</td>
<td>60 (48)</td>
<td>4.43</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>-</td>
<td>-</td>
<td>3 (6)</td>
<td>11 (21)</td>
<td>38 (73)</td>
<td>4.67</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>-</td>
<td>-</td>
<td>6 (10)</td>
<td>21 (35)</td>
<td>33 (55)</td>
<td>4.45</td>
</tr>
<tr>
<td></td>
<td>STs (353)</td>
<td>-</td>
<td>30 (8)</td>
<td>128 (36)</td>
<td>193 (55)</td>
<td></td>
<td>4.45</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>-</td>
<td>3 (9)</td>
<td>14 (41)</td>
<td>17 (50)</td>
<td></td>
<td>4.41</td>
</tr>
<tr>
<td>4.2d Co-operative learning</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (118)</td>
<td>-</td>
<td>3 (3)</td>
<td>18 (15)</td>
<td>58 (49)</td>
<td>39 (33)</td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>-</td>
<td>4 (3)</td>
<td>18 (15)</td>
<td>67 (54)</td>
<td>35 (28)</td>
<td>4.07</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>-</td>
<td>-</td>
<td>6 (12)</td>
<td>16 (31)</td>
<td>30 (58)</td>
<td>4.46</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>1 (2)</td>
<td>1 (2)</td>
<td>14 (23)</td>
<td>27 (45)</td>
<td>17 (28)</td>
<td>3.97</td>
</tr>
<tr>
<td></td>
<td>STs (354)</td>
<td>1 (-)</td>
<td>8 (2)</td>
<td>56 (16)</td>
<td>168 (47)</td>
<td>121 (34)</td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>-</td>
<td>9 (26)</td>
<td>18 (53)</td>
<td>7 (21)</td>
<td></td>
<td>3.94</td>
</tr>
</tbody>
</table>
### Table 4.29: Distribution of frequencies for the use of different teaching strategies

<table>
<thead>
<tr>
<th>Teaching Strategy</th>
<th>Participants(N)</th>
<th>never (%)</th>
<th>seldom (%)</th>
<th>sometimes (%)</th>
<th>Often (%)</th>
<th>very often (%)</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Year (118)</td>
<td>12 (10)</td>
<td>35 (30)</td>
<td>33 (28)</td>
<td>30 (25)</td>
<td>8 (7)</td>
<td>2.89</td>
</tr>
<tr>
<td></td>
<td>2nd Year (124)</td>
<td>9 (7)</td>
<td>39 (31)</td>
<td>50 (40)</td>
<td>23 (19)</td>
<td>3 (2)</td>
<td>2.77</td>
</tr>
<tr>
<td></td>
<td>3rd Year (50)</td>
<td>2 (4)</td>
<td>20 (40)</td>
<td>18 (36)</td>
<td>7 (14)</td>
<td>3 (6)</td>
<td>2.78</td>
</tr>
<tr>
<td>Journal writing</td>
<td>4th Year (60)</td>
<td>18 (30)</td>
<td>21 (35)</td>
<td>16 (27)</td>
<td>3 (5)</td>
<td>2 (3)</td>
<td>2.17</td>
</tr>
<tr>
<td></td>
<td>STs (352)</td>
<td>41 (12)</td>
<td>115 (33)</td>
<td>117 (33)</td>
<td>63 (18)</td>
<td>16 (5)</td>
<td>2.71</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>9 (26)</td>
<td>10 (29)</td>
<td>11 (32)</td>
<td>3 (9)</td>
<td>1 (3)</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>1st Year (114)</td>
<td>1 (1)</td>
<td>9 (8)</td>
<td>36 (32)</td>
<td>54 (47)</td>
<td>14 (12)</td>
<td>3.62</td>
</tr>
<tr>
<td></td>
<td>2nd Year (124)</td>
<td>-</td>
<td>7 (6)</td>
<td>40 (32)</td>
<td>63 (51)</td>
<td>14 (11)</td>
<td>3.68</td>
</tr>
<tr>
<td></td>
<td>3rd Year (51)</td>
<td>-</td>
<td>5 (10)</td>
<td>11 (22)</td>
<td>24 (47)</td>
<td>11 (22)</td>
<td>3.80</td>
</tr>
<tr>
<td></td>
<td>4th Year (57)</td>
<td>-</td>
<td>3 (5)</td>
<td>17 (30)</td>
<td>23 (40)</td>
<td>14 (25)</td>
<td>3.84</td>
</tr>
<tr>
<td>Resource-based learning</td>
<td>STs (346)</td>
<td>1 (-)</td>
<td>24 (7)</td>
<td>104 (30)</td>
<td>164 (47)</td>
<td>53 (15)</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>1 (3)</td>
<td>3 (9)</td>
<td>8 (24)</td>
<td>16 (53)</td>
<td>4 (4)</td>
<td>3.62</td>
</tr>
<tr>
<td></td>
<td>1st Year (117)</td>
<td>1 (1)</td>
<td>4 (3)</td>
<td>34 (29)</td>
<td>60 (51)</td>
<td>18 (15)</td>
<td>3.77</td>
</tr>
<tr>
<td></td>
<td>2nd Year (124)</td>
<td>-</td>
<td>4 (3)</td>
<td>35 (28)</td>
<td>62 (50)</td>
<td>23 (19)</td>
<td>3.84</td>
</tr>
<tr>
<td></td>
<td>3rd Year (52)</td>
<td>-</td>
<td>-</td>
<td>10 (19)</td>
<td>30 (58)</td>
<td>12 (23)</td>
<td>4.04</td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>-</td>
<td>6 (10)</td>
<td>20 (34)</td>
<td>25 (42)</td>
<td>8 (14)</td>
<td>3.59</td>
</tr>
<tr>
<td>Guided discovery</td>
<td>STs (352)</td>
<td>1 (-)</td>
<td>14 (4)</td>
<td>99 (28)</td>
<td>177 (50)</td>
<td>61 (17)</td>
<td>3.80</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>1 (3)</td>
<td>4 (12)</td>
<td>13 (38)</td>
<td>13 (38)</td>
<td>3 (9)</td>
<td>3.38</td>
</tr>
<tr>
<td></td>
<td>1st Year (117)</td>
<td>3 (93)</td>
<td>15 (13)</td>
<td>54 (46)</td>
<td>39 (33)</td>
<td>6 (5)</td>
<td>3.26</td>
</tr>
<tr>
<td></td>
<td>2nd Year (124)</td>
<td>2 (2)</td>
<td>22 (18)</td>
<td>61 (49)</td>
<td>35 (28)</td>
<td>4 (3)</td>
<td>3.14</td>
</tr>
<tr>
<td></td>
<td>3rd Year (51)</td>
<td>-</td>
<td>12 (24)</td>
<td>29 (57)</td>
<td>10 (20)</td>
<td>-</td>
<td>2.96</td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>3 (5)</td>
<td>12 (20)</td>
<td>28 (47)</td>
<td>16 (27)</td>
<td>-</td>
<td>2.97</td>
</tr>
<tr>
<td>Regular written tests</td>
<td>STs (351)</td>
<td>8 (2)</td>
<td>61 (17)</td>
<td>172 (49)</td>
<td>100 (28)</td>
<td>10 (3)</td>
<td>3.12</td>
</tr>
<tr>
<td></td>
<td>PTs (34)</td>
<td>2 (6)</td>
<td>3 (9)</td>
<td>17 (50)</td>
<td>10 (29)</td>
<td>2 (6)</td>
<td>3.21</td>
</tr>
</tbody>
</table>
About 91% of both student teachers and practising teachers noted that they ‘often’ used or intended to ‘often’ use ‘hands-on experience’ in their teaching. The intention to ‘often’ use ‘co-operative learning’ as a teaching strategy was shown by 84% of the student teachers and 74% of the practising teachers. However, their mean values (4.13 for student teachers and 3.94 for practising teachers) show that they had similar levels of intention for the use of ‘co-operative learning’. ‘Regular written tests’ as a teaching strategy was also noted as their intention by both student teachers and practising teachers at a similar level (mean for student teachers = 3.12 & mean for practising teachers =3.21).

Although the mean values for the intention to use different teaching strategies show similarity between student teachers and practising teachers in this study, Chi Square tests were carried out to find out any significant difference in the intention for different teaching strategies across status of participants and across year levels of student teachers. On the recommendation by Burns (2000), as stated before, responses marked ‘never’ and ‘seldom’ were collapsed into the ‘seldom’ group while responses marked ‘often’ and ‘very often’ were collapsed into the ‘often’ group in order to make the expected frequencies in as many cells to be equal or greater than the value ‘five’. Table 4.30 and Table 4.31 present summaries of significant Chi Square analysis for status of participants and for year level of student teachers respectively on the intention to teach different teaching strategies.
Table 4.30: Summary of Chi Square Analysis on the preference to teaching strategies

<table>
<thead>
<tr>
<th>Teaching strategy</th>
<th>Status of participant</th>
<th>Year level of student teachers</th>
<th>chi square</th>
<th>p</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill and practice</td>
<td></td>
<td></td>
<td>0.15</td>
<td>0.928</td>
<td>26.67**</td>
<td>0.0002</td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
<td></td>
<td>8.54**</td>
<td>0.014</td>
<td>3.05</td>
<td>0.803</td>
</tr>
<tr>
<td>Hands-on experience</td>
<td></td>
<td></td>
<td>0.20</td>
<td>0.906</td>
<td>7.99</td>
<td>0.239</td>
</tr>
<tr>
<td>Co-operative learning</td>
<td></td>
<td></td>
<td>3.22</td>
<td>0.200</td>
<td>5.41</td>
<td>0.492</td>
</tr>
<tr>
<td>Journal writing</td>
<td></td>
<td></td>
<td>2.57</td>
<td>0.277</td>
<td>21.55**</td>
<td>0.0015</td>
</tr>
<tr>
<td>Resource-based learning</td>
<td></td>
<td></td>
<td>1.30</td>
<td>0.521</td>
<td>3.60</td>
<td>0.731</td>
</tr>
<tr>
<td>Guided discovery</td>
<td></td>
<td></td>
<td>9.61**</td>
<td>0.008</td>
<td>12.11</td>
<td>0.060</td>
</tr>
<tr>
<td>Regular written tests</td>
<td></td>
<td></td>
<td>0.55</td>
<td>0.758</td>
<td>7.82</td>
<td>0.252</td>
</tr>
</tbody>
</table>

Table 4.31: Summary of Significant Chi Square Analysis for Status of Participants on the preferences to Teaching Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Status of participants</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided discovery</td>
<td>STs (352) PTs (34)</td>
<td>15 (4%)</td>
<td>99 (28%)</td>
<td>238 (68%)</td>
<td>9.61</td>
<td>0.008</td>
</tr>
<tr>
<td>Problem solving</td>
<td>STs (356) PTs (34)</td>
<td>6 (2%)</td>
<td>9 (27%)</td>
<td>25 (73%)</td>
<td>8.54</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Table 4.32: Summary of Significant Chi Square Analysis for Year Level of Student Teachers on the preferences to Teaching Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Year level of student teachers</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill and practice</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (115)</td>
<td>29 (25%)</td>
<td>33 (29%)</td>
<td>53 (46%)</td>
<td>26.67</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>10 (8%)</td>
<td>47 (38%)</td>
<td>67 (54%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (52)</td>
<td>4 (8%)</td>
<td>29 (56%)</td>
<td>19 (37%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>5 (8%)</td>
<td>27 (45%)</td>
<td>28 (47%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journal writing</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year (118)</td>
<td>47 (40%)</td>
<td>33 (28%)</td>
<td>38 (32%)</td>
<td>21.55</td>
<td>0.0015</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year (124)</td>
<td>48 (39%)</td>
<td>50 (40%)</td>
<td>26 (21%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year (50)</td>
<td>22 (44%)</td>
<td>18 (36%)</td>
<td>10 (20%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Year (60)</td>
<td>39 (65%)</td>
<td>16 (27%)</td>
<td>5 (8%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This study found significant differences in the preferences made by student teachers and practising teachers in two of the teaching strategies: 'guided discovery' and 'problem solving'. Student teachers displayed stronger preferences than practising teachers for 'guided discovery' (chi square = 9.61, p = 0.008) and for 'problem solving (chi square = 8.54, p = 0.014). Sixty-eight per cent of the student teachers intended to 'often' use 'guided discovery' while only 47% of the practising teachers 'often' used it. Further, 88% of the student teachers intended to 'often' use problem solving while only 73% of the practising teachers 'often' used it.

Table 4.32 shows that there were significant differences in the preferences of student teachers across different year levels in two of the teaching strategies. There was a highly significant difference in the preference for 'drill and practice' (chi square = 26.67, p = 0.0002). 25% of the 1st year student teachers noted that they would 'seldom' use 'drill and practice' as a teaching strategy in mathematics while only 8% of the 2nd year, 3rd year and 4th year student teachers noted that they would 'seldom' use this strategy. This shows an increasing intention to use drills over the course. It was also found that there was a highly significant difference in the preferences for 'journal writing' (chi square = 21.55, p = 0.0015). 65% of the 4th year student teachers noted that they would 'seldom' use 'journal writing' as a teaching strategy in mathematics while only 40% of the 1st year student teachers, 39% of the 2nd year student teachers and 44% of the 1st year student teachers noted that they would 'seldom' use this strategy. In general, student teachers realize over the course that all kinds of approach are of real value.
To sum up, both practising teachers and student teachers in the sample of this study, on average, were willing to ‘often’ use ‘hands-on experience’, ‘co-operative learning’, ‘resource-based learning’, ‘guided discovery’ and ‘drill and practice’ as teaching strategies for mathematics teaching. Student teachers’ willingness to use ‘regular written tests’ was seen to decrease in 3rd and 4th year. ‘Journal writing’ as a teaching strategy was not popular among either practising teachers and student teachers of this study.

4.4.4 Training for a competent mathematics teacher
The purpose of training teachers is to develop competencies in them. In general, teachers are expected to develop competencies in content of a subject, its teaching and the psychological basis for teaching the subject.

Question 4.3 of both Teacher Questionnaire and Student Teacher Questionnaire asked about the kinds of training they felt they needed to become competent teachers of primary mathematics. These were listed as follows:

- Maths content – up to Year 6 competency is sufficient
- Maths content – up to Year 12
- Maths teaching methods – understanding the role of maths in society
- Maths teaching methods – integrating maths with other KLAs
- Psychological basis for teaching of maths.

Student teachers and practising teachers in this study were asked zs in previous questions to record their level of agreement on a Likert-type scale ranging from ‘strongly disagree’ to ‘strongly agree’.
## Table 4.33: Distribution of frequencies for the kinds of training the participants felt needed

<table>
<thead>
<tr>
<th>Kind of Training</th>
<th>Participants (N)</th>
<th>SA (%)</th>
<th>A (%)</th>
<th>U (%)</th>
<th>D (%)</th>
<th>SD (%)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maths content up to Year 6 competency is sufficient</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year (117)</td>
<td>39 (33)</td>
<td>27 (23)</td>
<td>9 (8)</td>
<td></td>
<td>27 (23)</td>
<td>15 (12)</td>
<td>3.41</td>
</tr>
<tr>
<td>2nd Year (123)</td>
<td>36 (29)</td>
<td>29 (24)</td>
<td>14 (11)</td>
<td>5 (10)</td>
<td>29 (24)</td>
<td>15 (12)</td>
<td>3.34</td>
</tr>
<tr>
<td>3rd Year (50)</td>
<td>21 (42)</td>
<td>6 (12)</td>
<td>5 (10)</td>
<td>4 (7)</td>
<td>11 (22)</td>
<td>7 (14)</td>
<td>3.46</td>
</tr>
<tr>
<td>4th Year (59)</td>
<td>20 (34)</td>
<td>16 (27)</td>
<td></td>
<td></td>
<td>11 (19)</td>
<td>8 (14)</td>
<td>3.49</td>
</tr>
<tr>
<td>STs (349)</td>
<td>116 (33)</td>
<td>78 (22)</td>
<td>32 (9)</td>
<td></td>
<td>78 (22)</td>
<td>45 (13)</td>
<td>3.41</td>
</tr>
<tr>
<td>PTs (34)</td>
<td>9 (26)</td>
<td>7 (21)</td>
<td>3 (9)</td>
<td></td>
<td>11 (32)</td>
<td>4 (12)</td>
<td>3.18</td>
</tr>
<tr>
<td><strong>Maths content – up to Year 12</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year (117)</td>
<td>27 (23)</td>
<td>45 (38)</td>
<td>24 (21)</td>
<td>21 (18)</td>
<td>-</td>
<td>3.67</td>
<td></td>
</tr>
<tr>
<td>2nd Year (123)</td>
<td>13 (11)</td>
<td>60 (49)</td>
<td>30 (24)</td>
<td>15 (12)</td>
<td>5 (4)</td>
<td>3.50</td>
<td></td>
</tr>
<tr>
<td>3rd Year (50)</td>
<td>7 (14)</td>
<td>21 (42)</td>
<td>12 (24)</td>
<td>8 (16)</td>
<td>2 (4)</td>
<td>3.46</td>
<td></td>
</tr>
<tr>
<td>4th Year (59)</td>
<td>10 (17)</td>
<td>22 (37)</td>
<td>13 (22)</td>
<td>12 (20)</td>
<td>2 (3)</td>
<td>3.44</td>
<td></td>
</tr>
<tr>
<td>STs (349)</td>
<td>57 (16)</td>
<td>148 (42)</td>
<td>79 (23)</td>
<td>56 (16)</td>
<td>9 (3)</td>
<td>3.54</td>
<td></td>
</tr>
<tr>
<td>PTs (32)</td>
<td>4 (13)</td>
<td>9 (28)</td>
<td>6 (19)</td>
<td>10 (31)</td>
<td>3 (9)</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td><strong>Maths teaching methods – understanding the role of maths in society.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year (117)</td>
<td>55 (47)</td>
<td>54 (46)</td>
<td>6 (5)</td>
<td>2 (2)</td>
<td>-</td>
<td>4.38</td>
<td></td>
</tr>
<tr>
<td>2nd Year (123)</td>
<td>48 (39)</td>
<td>66 (54)</td>
<td>7 (6)</td>
<td>2 (2)</td>
<td>-</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>3rd Year (51)</td>
<td>28 (55)</td>
<td>22 (43)</td>
<td>1 (2)</td>
<td>-</td>
<td>-</td>
<td>4.53</td>
<td></td>
</tr>
<tr>
<td>4th Year (58)</td>
<td>21 (36)</td>
<td>32 (55)</td>
<td>3 (5)</td>
<td>2 (3)</td>
<td>-</td>
<td>4.21</td>
<td></td>
</tr>
<tr>
<td>STs (349)</td>
<td>152 (44)</td>
<td>174 (50)</td>
<td>17 (5)</td>
<td>6 (2)</td>
<td>-</td>
<td>4.35</td>
<td></td>
</tr>
<tr>
<td>PTs (34)</td>
<td>14 (41)</td>
<td>15 (44)</td>
<td>4 (12)</td>
<td>1 (3)</td>
<td>-</td>
<td>4.24</td>
<td></td>
</tr>
<tr>
<td>Kind of Training</td>
<td>Participants (N)</td>
<td>SA (%)</td>
<td>A (%)</td>
<td>U (%)</td>
<td>D (%)</td>
<td>SD (%)</td>
<td>Mean</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>------------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Maths teaching methods - integrating maths with other KLAs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year (118)</td>
<td>56 (47)</td>
<td>48 (41)</td>
<td>12 (10)</td>
<td>2 (2)</td>
<td>-</td>
<td>4.34</td>
<td></td>
</tr>
<tr>
<td>2nd Year (123)</td>
<td>56 (46)</td>
<td>63 (51)</td>
<td>3 (2)</td>
<td>-</td>
<td>1 (1)</td>
<td>4.41</td>
<td></td>
</tr>
<tr>
<td>3rd Year (51)</td>
<td>36 (71)</td>
<td>15 (29)</td>
<td>1 (2)</td>
<td>1 (2)</td>
<td>-</td>
<td>4.71</td>
<td></td>
</tr>
<tr>
<td>4th Year (59)</td>
<td>24 (41)</td>
<td>33 (56)</td>
<td></td>
<td></td>
<td>-</td>
<td>4.36</td>
<td></td>
</tr>
<tr>
<td>STs (351)</td>
<td>172 (49)</td>
<td>159 (45)</td>
<td>16 (5)</td>
<td>3 (1)</td>
<td>1</td>
<td>4.42</td>
<td></td>
</tr>
<tr>
<td>PTs (34)</td>
<td>12 (35)</td>
<td>18 (53)</td>
<td>3 (9)</td>
<td>1 (3)</td>
<td>-</td>
<td>4.21</td>
<td></td>
</tr>
<tr>
<td><strong>Psychological basis for teaching of maths</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year (117)</td>
<td>10 (9)</td>
<td>40 (34)</td>
<td>55 (48)</td>
<td>10 (9)</td>
<td>1 (1)</td>
<td>3.41</td>
<td></td>
</tr>
<tr>
<td>2nd Year (123)</td>
<td>12 (10)</td>
<td>45 (37)</td>
<td>60 (49)</td>
<td>6 (5)</td>
<td>-</td>
<td>3.51</td>
<td></td>
</tr>
<tr>
<td>3rd Year (50)</td>
<td>2 (4)</td>
<td>12 (24)</td>
<td>29 (58)</td>
<td>7 (14)</td>
<td>-</td>
<td>3.18</td>
<td></td>
</tr>
<tr>
<td>4th Year (59)</td>
<td>5 (8)</td>
<td>17 (29)</td>
<td>26 (44)</td>
<td>10 (17)</td>
<td>-</td>
<td>3.25</td>
<td></td>
</tr>
<tr>
<td>STs (350)</td>
<td>29 (8)</td>
<td>114 (33)</td>
<td>171 (49)</td>
<td>33 (9)</td>
<td>2 (1)</td>
<td>3.38</td>
<td></td>
</tr>
<tr>
<td>PTs (33)</td>
<td>4 (12)</td>
<td>12 (36)</td>
<td>13 (39)</td>
<td>3 (9)</td>
<td>1 (3)</td>
<td>3.45</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.34 presents an account of the frequency distribution for the responses reported by student teachers and practising teachers about the kind of training necessary for a competent teacher of primary mathematics. It was found that the mean value calculated for each kind of training was above 'three'. In other words, both student teachers and practising teachers noted that they were in agreement with that all five kinds of training were necessary to become a competent teacher in primary mathematics. However, this agreement was stronger for 'maths teaching methods – integrating maths with other KLAs' and for 'maths teaching methods – understanding the role of maths in society' than for the other three.

When the responses marked 'SA' (strongly agree) and 'A' (agree) were collapsed into the 'agree' group while responses marked 'D' (disagree) and 'SD' (strongly disagree) were collapsed into the 'disagree' group, Chi Square analysis was carried out to find any significant differences across status of participants and across year level of student teachers.

Table 4.34: Summary of Chi Square Analysis on the preferences to kind of training

<table>
<thead>
<tr>
<th>Kind of training</th>
<th>Status of participant</th>
<th>Year level of STs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>chi square</td>
<td>p</td>
</tr>
<tr>
<td>Maths content up to Year 6 competency is sufficient</td>
<td>1.59</td>
<td>0.451</td>
</tr>
<tr>
<td>Maths content – up to Year 12</td>
<td>8.81**</td>
<td>0.012</td>
</tr>
<tr>
<td>Maths teaching methods – understanding the role of maths in society.</td>
<td>3.14</td>
<td>0.208</td>
</tr>
<tr>
<td>Maths teaching methods – integrating maths with other KLAs</td>
<td>2.04</td>
<td>0.361</td>
</tr>
<tr>
<td>Psychological basis for teaching of maths</td>
<td>0.64</td>
<td>0.725</td>
</tr>
</tbody>
</table>
Table 4.35: Summary of significant Chi Square Analysis for Status of participants on the preferences to kind of training

<table>
<thead>
<tr>
<th>Kind of Training</th>
<th>Status of Participant</th>
<th>Agree (%)</th>
<th>Uncertain (%)</th>
<th>Disagree (%)</th>
<th>Chi Square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maths content up to Year 12</td>
<td>STs (349)</td>
<td>205 (59%)</td>
<td>79 (23%)</td>
<td>65 (19%)</td>
<td>8.81</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>PTs (32)</td>
<td>13 (41%)</td>
<td>6 (19%)</td>
<td>13 (41%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.36: Summary of significant Chi Square Analysis for Year Level of Student Teachers on the preferences to kind of training

<table>
<thead>
<tr>
<th>Kind of Training</th>
<th>Year Level of Student Teachers</th>
<th>Agree (%)</th>
<th>Uncertain (%)</th>
<th>Disagree (%)</th>
<th>Chi Square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maths teaching methods - integrating maths with other KLAs</td>
<td>1st Year (118)</td>
<td>104 (88)</td>
<td>12 (10)</td>
<td>2 (2)</td>
<td>14.69</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>2nd Year (123)</td>
<td>119 (97)</td>
<td>3 (2)</td>
<td>1 (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year (51)</td>
<td>51 (100)</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>57 (97)</td>
<td>1 (2)</td>
<td>1 (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological basis for teaching of maths</td>
<td>1st Year (117)</td>
<td>50 (45)</td>
<td>56 (48)</td>
<td>11 (9)</td>
<td>12.81</td>
<td>0.046</td>
</tr>
<tr>
<td></td>
<td>2nd Year (123)</td>
<td>57 (46)</td>
<td>60 (49)</td>
<td>6 (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year (50)</td>
<td>14 (28)</td>
<td>29 (58)</td>
<td>7 (14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Year (59)</td>
<td>22 (37)</td>
<td>26 (44)</td>
<td>11 (19)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.35 shows that there was a statistically significant difference across the status of participants only for the kind of training on ‘maths content – up to Year 12’ (chi square = 8.81, p = 0.012). It was also found that 58% of the student teachers agreed with the need for the training on ‘maths content – up to Year 12’ while 41% of the practising teachers agreed with it.

Chi Square analysis also revealed that there were significant differences in the level of agreement across the year level of student teachers on two kinds of training that they felt they need to become a competent teacher. This is presented is Table 4.36. One significant difference was on ‘maths teaching methods – integrating with other KLAs’ (chi square = 14.69, p = 0.023). Above 97% of the student teachers in 2nd year, 3rd year and 4th year levels agreed with the need for this kind of training while only 88% of the 1st year student teachers agreed with it. It was also found that all 3rd year student teachers were in
agreement with this. These findings show that the student teachers changed their views after 1\textsuperscript{st} year.

The second significant difference was on 'psychological basis for teaching of maths' (chi square = 12.81, p = 0.046). 43\% of the 1\textsuperscript{st} year student teachers and 46\% of the 2\textsuperscript{nd} year student teachers agreed with the need for this kind of training while only 28\% of the 3\textsuperscript{rd} year student teachers and 37 \% of the 4\textsuperscript{th} year student teachers agreed with it. This shows that the student teachers perceived the need for training on 'psychological basis for teaching of maths' as less important in their 3\textsuperscript{rd} year and 4\textsuperscript{th} year of study. This is also indicated by the mean values obtained with the responses for each year level (1\textsuperscript{st} year: mean = 3.41, 2\textsuperscript{nd} year: mean = 3.51, 3\textsuperscript{rd} year: mean = 3.18, 4\textsuperscript{th} year: mean = 3.25)

To summarise, both practising teachers and student teachers of this study felt that all kinds of training – maths content up to Year 12, maths teaching methods to understand the role of maths in society and to integrate maths with other KLAs, and the psychological basis for teaching of maths – were needed to become a competent teacher of primary mathematics.

\textbf{4.4.5 Enthusiasm for teaching mathematics}

When practising teachers were asked to record how they would rate their enthusiasm for teaching mathematics compared to other KLAs, their responses were distributed as shown in Table 4.37.
Table 4.37: Practising Teachers’ Enthusiasm for Teaching mathematics compared to other KLAs.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than any of the others</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>9%</td>
</tr>
<tr>
<td>Less than English or HSIE</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>About the same as others</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>18</td>
<td>53%</td>
</tr>
<tr>
<td>One of my favourite together with English or HSIE or Science</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>24%</td>
</tr>
<tr>
<td>The most enjoyable</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>12%</td>
</tr>
</tbody>
</table>

The frequency distribution of the responses shows that 89% of the practising teachers of this study noted that they had enthusiasm for teaching mathematics greater than or equal to that for other KLAs.

When these ratings from ‘less than any of the others’ to ‘the most enjoyable’ were assigned values of 1, 2, 3, 4 and 5 respectively, the mean value shows that, on average, the enthusiasm for teaching mathematics was above that for other KLAs (mean = 3.26).

In order to describe their level of enthusiasm for teaching mathematics, the participant teachers were asked to supply three suitable key words. 23 key words were supplied by 30 teachers while four teachers did not respond to this question. These key words are grouped according to their similarity or likeness in meaning and are presented in Table 4.38.
Table 4.38: Teachers' Description of their Level of Enthusiasm for Teaching Maths

<table>
<thead>
<tr>
<th>Key words supplied to show the level of enthusiasm</th>
<th>Actual no. of responses</th>
<th>Percentage of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fascinating/interesting/aspiring/engaged/focused/exciting/enthusiastic/fun/enjoyable</td>
<td>24</td>
<td>80%</td>
</tr>
<tr>
<td>Worthwhile/valued/rewarding</td>
<td>22</td>
<td>73%</td>
</tr>
<tr>
<td>Challenging/problem solving</td>
<td>18</td>
<td>60%</td>
</tr>
<tr>
<td>Productive/useful</td>
<td>16</td>
<td>53%</td>
</tr>
<tr>
<td>Difficult/hard</td>
<td>6</td>
<td>20%</td>
</tr>
<tr>
<td>Necessary/important</td>
<td>3</td>
<td>10%</td>
</tr>
<tr>
<td>Boring</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>

It is interesting to note that their enthusiasm for teaching mathematics was high among the practising teachers although their level of enthusiasm for teaching mathematics was slightly above the level of enthusiasm for other KLAs. This concern towards mathematics was also shown by the responses given to Question 5.1 of the Teacher Questionnaire.

Question 5.1 of the Teacher Questionnaire asked how much mathematics teaching did the participant teachers do per week. Table 4.39 provides their time allocation for teaching mathematics.

Table 4.39: Time Allocation for Teaching Mathematics

<table>
<thead>
<tr>
<th>Class</th>
<th>Time allocation for teaching maths (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sydney Public</td>
</tr>
<tr>
<td>Year K</td>
<td>160</td>
</tr>
<tr>
<td>Year K / 1</td>
<td>90</td>
</tr>
<tr>
<td>Year 1</td>
<td>90</td>
</tr>
<tr>
<td>Year 1 / 2</td>
<td>-</td>
</tr>
</tbody>
</table>
It was found that the average time spent for mathematics teaching by the 32 teachers was 247 minutes per week. However, nearly half of the teachers (47%) spent 5 hours per week in teaching mathematics.

In short, practising teachers of this study, on average, rated their enthusiasm for mathematics teaching was nearly the same as for other KLAs. Also, their time of allocation for mathematics teaching and the descriptions of their enthusiasm for teaching of maths show that, on average, they had much concern towards mathematics teaching.

4.4.6 Working Environment

Estimation of the ability level of learners is important for teachers in planning their instructional activities. Question 5.2 and Question 5.3 of the Teacher Questionnaire asked about the practising teachers' estimation of their students' ability level. Table 1 shows the frequency distribution of teacher responses to
Question 5.3. Each response from 'remedial' to 'accelerated' was assigned a value from 1 to 5 respectively and the mean value for each school was calculated.

Table 4.40: Teachers' Responses to the Question 'How would you characterise the average ability level in your class in relation to the expected maths outcomes for their age group?'

<table>
<thead>
<tr>
<th>School</th>
<th>Remedial</th>
<th>Slightly below average</th>
<th>Average</th>
<th>Slightly above average</th>
<th>Accelerated</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney Pub. (12)</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>-</td>
<td>1</td>
<td>2.50</td>
</tr>
<tr>
<td>Sydney Indep. (6)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2.00</td>
</tr>
<tr>
<td>Wollong. Cath. (8)</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>-</td>
<td>3.25</td>
</tr>
<tr>
<td>Wollong. Pub. (8)</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>3.00</td>
</tr>
<tr>
<td>Total (34)</td>
<td>3 (9%)</td>
<td>11 (32%)</td>
<td>14 (41%)</td>
<td>5 (15%)</td>
<td>1 (3%)</td>
<td>2.71</td>
</tr>
</tbody>
</table>

It is clear from the last column of Table 4.40, that the participant teachers of this study rated the ability levels of their classes in relation to the expected maths outcomes for their age group as close to average (mean = 2.71). This may be because the schools under consideration were from socio-economically disadvantaged areas. In particular, among the four schools under study, Sydney independent school teachers of this study estimated their pupils' ability level as at the lowest level (mean = 2.0).

Table 4.41 provides the frequency distribution of the teachers' responses to Question 5.2. This question asked about the degree of homogeneity in maths ability of their classes. The participant teachers of this study were asked to note their responses in a five-point Likert-type scale ranging from 'little range in ability' to 'extreme range'. Each response was assigned a value of 1, 2, 3, 4 and 5 respectively in the order from 'little range in ability' to 'extreme range'. Mean value for each school was calculated and presented in Table 4.41.
Table 4.41 reveals that, on average, the teachers estimated the homogeneity of the math ability in their classes were above normal range (mean = 3.74). Among all four schools, Wollongong public school teachers of this study estimated that the homogeneity of math ability in their classes were of large range (mean = 4.13).

These results indicate an important task that the teachers of this study had to face with in relation to their mathematics teaching. As the homogeneity of the math ability in their classes were of large range, on average, it would be far less easy for the teachers of this study to treat their classes as a homogeneous group for all teaching purposes. This could have a significant influence on teaching strategies and assessment methods.

Practising teachers of this study reported that they ‘very often’ used ‘hands-on experiences’ as a teaching strategy (Table 4.29). They also indicated that they ‘often’ used problem solving, cooperative learning, resource-based learning, guided discovery, and drill and practice as other teaching strategies. Use of a variety of these teaching strategies shows that the practising teachers of this study had concern about the diversity of their students.
4.4.7 Mathematics teaching, mathematics learning and its assessment

Question 6.1 of the Teacher Questionnaire asked practising teachers to characterise a typical math lesson by setting out the pattern of such a lesson. Tables 4.42, 4.43, 4.44 & 4.45 represent their descriptions of a typical math lesson.

Table 4.42: Teachers Descriptions of typical math lessons — Sydney public school

<table>
<thead>
<tr>
<th>Teacher 1:</th>
<th>Teacher 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Teacher introduces the lesson using concrete materials .</td>
<td>1 Whole class games as introduction .</td>
</tr>
<tr>
<td>2 Children model what the teacher has shown them using concrete materials in groups .</td>
<td>2 Break into two groups; each group uses concrete resources .</td>
</tr>
<tr>
<td>3 Teacher gives some activities .</td>
<td>3 Complete worksheet .</td>
</tr>
<tr>
<td>4 Follow-up lesson the next day may be with some formal writing/recording in a textbook .</td>
<td>4 Whole class discussion on maths learnt .</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 3:</th>
<th>Teacher 4:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sing times tables .</td>
<td>1 use of textbook — ability groups .</td>
</tr>
<tr>
<td>2 Discuss/introduce lesson .</td>
<td>2 Discuss activity with whole class .</td>
</tr>
<tr>
<td>3 Complete page(s) of textbook with or without concrete materials .</td>
<td>3 Each group completes up to their level; hands-on activities are usual .</td>
</tr>
<tr>
<td>4 Conclude — quick quiz; usually oral .</td>
<td>4 Discuss at the end of time .</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 5:</th>
<th>Teacher 6:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Whole class explanation — activity</td>
<td>1 Introduce concept with hands-on activities</td>
</tr>
<tr>
<td>2 Small group work with extension for top</td>
<td>2 Consolidate using a textbook</td>
</tr>
<tr>
<td>3 Whole class discuss activities, methods, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 7:</th>
<th>Teacher 8:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Formal teaching of material</td>
<td>1 Demonstration</td>
</tr>
<tr>
<td>2 Children work on examples .</td>
<td>2 Practice</td>
</tr>
</tbody>
</table>

Note: Teachers were asked, How would you characterise a typical math lesson — what pattern would the lesson follow?  
** Two teachers did not describe a sequence of activity segments and therefore their responses are not included. Two other teachers did not respond to this question.
Table 4.43: Teachers Descriptions of typical math lessons — Wollongong public school

<table>
<thead>
<tr>
<th>Teacher 1:</th>
<th>Teacher 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Introduction — class together.</td>
<td>1  Drill/game</td>
</tr>
<tr>
<td>2  Practise (in pairs or individuals)concept being dealt with.</td>
<td>2  Whole group learning</td>
</tr>
<tr>
<td>3  Complete a worksheet etc. to ascertain understanding</td>
<td>3  Individual or paired practice</td>
</tr>
<tr>
<td></td>
<td>4  Whole group checking</td>
</tr>
<tr>
<td></td>
<td>5  Game</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 3:</th>
<th>Teacher 4:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Game/revision</td>
<td>1  Modeling — teacher</td>
</tr>
<tr>
<td>2  Introduction</td>
<td>2  Guided instruction — teacher &amp;</td>
</tr>
<tr>
<td>3  Example — open-ended task to extendstudents</td>
<td>3  Independent practice</td>
</tr>
<tr>
<td>4  Check individual s work — help compare work</td>
<td>4  Revise/ assess needs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 5:</th>
<th>Teacher 6:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Game to revise recent concepts treated</td>
<td>1  Demonstration/Explanation</td>
</tr>
<tr>
<td>2  Twenty quick questions — first reinforcement</td>
<td>2  Investigation</td>
</tr>
<tr>
<td>3  Introduction of new concept</td>
<td>3  Practice</td>
</tr>
<tr>
<td>4  Set tasks</td>
<td></td>
</tr>
<tr>
<td>5  Correction and discussions of tasks, answers and solutions.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher 7:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(On a 4 day basis and the 5th day being assessment)</td>
<td></td>
</tr>
<tr>
<td>Day 1: Introduction to specific strands. Language and basics. Some write up and a couple of questions.</td>
<td></td>
</tr>
<tr>
<td>Day 2: Hands-on (if applicable) and more questions; look at the grey parts. Modify tests for above &amp; below abilities.</td>
<td></td>
</tr>
<tr>
<td>Day 3: Speed testing &amp; times tables.</td>
<td></td>
</tr>
<tr>
<td>Day 4: Group work for challenges to the topic &amp; easier work for those with difficulty.</td>
<td></td>
</tr>
<tr>
<td>Day 5: (Sometimes need 2 tests.)</td>
<td></td>
</tr>
</tbody>
</table>

** One teacher did not respond to this question.
**Table 4.44: Teachers Descriptions of typical math lessons — Sydney independent school**

<table>
<thead>
<tr>
<th>Teacher 1:</th>
<th>Teacher 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hands-on experience</td>
<td>1 Explanation</td>
</tr>
<tr>
<td>2 Explanation of activity</td>
<td>2 Hands-on</td>
</tr>
<tr>
<td>3 Activity</td>
<td>3 Bookwork</td>
</tr>
<tr>
<td>4 Conclusion</td>
<td></td>
</tr>
</tbody>
</table>

**Teacher 3:**
1 Hands-on demonstration
2 Work with lots of examples on the floor with students (practical activities)
3 Work in maths book

**Teacher 4:**
1 Drill on number
2 Hands-on activity for topic for the week
3 Discussion time — findings
4 Complete written tasks (or more hands-on activities)

**Teacher 5:**
1 Introduction using concrete materials
2 Modeling with concrete materials — children
3 Algorithm

**Teacher 6:**
1 Pose a problem
2 Explore solutions
3 Discuss the outcomes
4 Arrive at possible conclusions
5 What knowledge can be useful for future problems?

---

**Table 4.45: Teachers Descriptions of typical math lessons — Wollongong Catholic school**

<table>
<thead>
<tr>
<th>Teacher 1:</th>
<th>Teacher 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Introduce the task</td>
<td>1 Introduction</td>
</tr>
<tr>
<td>2 Group activities with concrete materials</td>
<td>2 Hands-on explanation</td>
</tr>
<tr>
<td>3 Short findings</td>
<td>3 whole class or group activity</td>
</tr>
<tr>
<td></td>
<td>4 Closing discussion or recording</td>
</tr>
</tbody>
</table>

**Teacher 3:**
1 Hands-on discovery
2 Group discussion/explanation
3 Small group activities with concrete materials
4 Recording or practise skills presented in lesson

**Teacher 4:**
1 Discussion
2 Hands-on discovery
3 Experimentation in small groups using concrete materials
4 Activity sheet — recording of discoveries

**Teacher 5:**
1 Model/demonstration
2 Hands-on activities
3 Individual approach
4 Share findings
5 Concluding statements — results

**Teacher 6:**
1 Discussion about task
2 Discussion about strategies
3 Co-operative learning — task completion
4 Review task

**One teacher did not describe a sequence of activity segments and therefore the response is not included. One other teacher did not respond to this question.**

125
Teachers' descriptions of typical math lessons presented in Tables 1, 2, 3 & 4 show that the teachers' normal routines consisted of a sequence of activities such as teacher introducing a new concept or skill with demonstration, students practising the new concept or skill completing worksheets or modeling what teacher had shown using concrete materials, and teacher correcting students work or discussing the results. Although this normal approach gives opportunity to gain hands-on experiences, it success depends on teachers' ability to use appropriate resource materials which is examined below and their enthusiasm towards mathematics teaching which has been examined above in section 4.4.5. A similar pattern was followed by each teacher except Teacher 6 from Sydney independent school who followed a problem solving approach. Teacher 7 from Wollongong public school described a pattern based on weekly activities. However, this teacher was also working in similar pattern but with the same type of activities sequenced on a 5-day basis.

4.4.8 Grouping during maths lessons

Grouping of students during maths lessons is important for the children to learn effectively when there is a large range of math ability in a class. As the practising teachers of this study rated that the range of math ability in their classes was large, it is interesting to know how they group their children.

When the practising teachers were asked how they would generally group the children during math lessons, the alternatives were individual work, in pairs, in groups by ability, collaborative groups and outdoor activities. Their responses were recorded under categories often, sometimes and never. Responses marked often, sometimes and never were assigned a value of 2, 1 and 0 respectively and the mean values were calculated for all four schools.
Table 4.46: Grouping the children during maths lessons

<table>
<thead>
<tr>
<th>Group</th>
<th>School</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual work</td>
<td>Sydney pub. (11)</td>
<td>5</td>
<td>6</td>
<td>-</td>
<td>1.45</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>2</td>
<td>6</td>
<td>-</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Total (33)</td>
<td>16 (48%)</td>
<td>17 (52%)</td>
<td>-</td>
<td>1.48</td>
</tr>
<tr>
<td>In pairs</td>
<td>Sydney pub. (11)</td>
<td>1</td>
<td>10</td>
<td>-</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>1</td>
<td>5</td>
<td>-</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>3</td>
<td>5</td>
<td>-</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Total (33)</td>
<td>11 (33%)</td>
<td>22 (67%)</td>
<td>-</td>
<td>1.33</td>
</tr>
<tr>
<td>In groups by ability</td>
<td>Sydney pub. (12)</td>
<td>9</td>
<td>3</td>
<td>-</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (7)</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Total (33)</td>
<td>11 (33%)</td>
<td>15 (45%)</td>
<td>7 (21%)</td>
<td>1.16</td>
</tr>
<tr>
<td>Collaborative groups</td>
<td>Sydney pub. (11)</td>
<td>4</td>
<td>7</td>
<td>-</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>1</td>
<td>5</td>
<td>-</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (7)</td>
<td>3</td>
<td>4</td>
<td>-</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>3</td>
<td>5</td>
<td>-</td>
<td>1.38</td>
</tr>
<tr>
<td></td>
<td>Total (32)</td>
<td>11 (34%)</td>
<td>21 (66%)</td>
<td>-</td>
<td>1.34</td>
</tr>
<tr>
<td>Outdoor activities</td>
<td>Sydney pub. (11)</td>
<td>-</td>
<td>10</td>
<td>1</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (7)</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>-</td>
<td>7</td>
<td>1</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Total (32)</td>
<td>2 (6%)</td>
<td>28 (88%)</td>
<td>2 (6%)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 4.46 provides the information regarding the grouping of children during math lessons. It is interesting to note that the Wollongong public school, which teachers perceived to have the largest range of maths ability, did not frequently use ability groups. On the other hand, they used a very high level of individual work and work in pairs.
All these results show that the teachers used grouping strategies, which would be appropriate in classes with a wide range of student ability. In addition to school-based activities, pupils may also be required to undertake maths learning activities at home.

Question 6.3 of the Teacher Questionnaire asked the practising teachers how often they gave homework in mathematics. Teachers' responses to this question are tabulated in Table 4.47.

**Table 4.47: Teachers' responses to the question, How often do you give homework in mathematics?**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Actual number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost every day</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>Every other day</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>Twice a week</td>
<td>3</td>
<td>9%</td>
</tr>
<tr>
<td>Once a week</td>
<td>14</td>
<td>42%</td>
</tr>
<tr>
<td>Not at all</td>
<td>6</td>
<td>18%</td>
</tr>
</tbody>
</table>

Thirty per cent of the practising teachers in this study were giving maths homework almost every day or every other day while 9% of the practising teachers were giving homework twice a week. However, 60% of the participant teachers stated that they were giving homework once a week or not at all.

### 4.4.9 Assessment of Mathematics Learning

An important part of the planning and implementation of teachers' programs is appropriate assessment. Question 6.4 asked about assessing children's progress. Teachers were asked to report on a 3-point Lykert-type scale how frequently they were using six other ways, namely, individual portfolios.
attainment tests, journal observations, worksheets, individual projects and group projects. Table 4.48 presents an account of the responses received. Each of the responses often, sometimes and never was given a value of 3, 2 and 1 respectively and the mean value for each assessment tool was calculated.

Overall, individual portfolios, worksheets and attainment tests were most popular among the teachers while journal observations, individual projects and group projects were not preferred by them. 65% of the subjects of this study reported that they were often using individual portfolios for assessment of children while 47% often used worksheets and 35% often used attainment tests as assessment tools. On the other hand, 45% of the practising teachers never used journal observations and group projects while 39% never used individual projects.

In particular, none of the teachers from Sydney independent school used journal observations. However, despite small differences in the mean values, the mean values show a similar level of preference to different assessment tools among the four schools.

Across the four schools, there was most agreement about the rating for individual portfolios and group projects. Sydney independent school never used journal observations. The greatest differences between schools occurred for journal observations where one school did not use this method largely than the others.
Table 4.48: Teachers Responses to the Question In what other ways do you assess the children’s progress?

<table>
<thead>
<tr>
<th>Assessment Tool</th>
<th>School</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual portfolios</td>
<td>Sydney pub. (12)</td>
<td>6</td>
<td>6</td>
<td>-</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>2.67</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>2.75</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>2.75</td>
</tr>
<tr>
<td>Total (34)</td>
<td>22 (65%)</td>
<td>12 (35%)</td>
<td>-</td>
<td>-</td>
<td>2.65</td>
</tr>
<tr>
<td>Attainment tests</td>
<td>Sydney pub. (12)</td>
<td>2</td>
<td>10</td>
<td>-</td>
<td>2.17</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>2.67</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>3</td>
<td>5</td>
<td>-</td>
<td>2.38</td>
</tr>
<tr>
<td>Total (34)</td>
<td>12 (35%)</td>
<td>20 (59%)</td>
<td>2 (6%)</td>
<td>-</td>
<td>2.29</td>
</tr>
<tr>
<td>Journal observations</td>
<td>Sydney pub. (12)</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (5)</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>1.75</td>
</tr>
<tr>
<td>Total (33)</td>
<td>4 (12%)</td>
<td>14 (42%)</td>
<td>15 (45%)</td>
<td>-</td>
<td>1.67</td>
</tr>
<tr>
<td>Worksheets</td>
<td>Sydney pub. (12)</td>
<td>5</td>
<td>7</td>
<td>-</td>
<td>2.42</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>5</td>
<td>1</td>
<td>-</td>
<td>2.83</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>2.50</td>
</tr>
<tr>
<td>Total (34)</td>
<td>16 (47%)</td>
<td>17 (50%)</td>
<td>1 (3%)</td>
<td>-</td>
<td>2.44</td>
</tr>
<tr>
<td>Individual projects</td>
<td>Sydney pub. (11)</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>2.73</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>1.75</td>
</tr>
<tr>
<td>Total (33)</td>
<td>1 (3%)</td>
<td>19 (58%)</td>
<td>13 (39%)</td>
<td>-</td>
<td>1.64</td>
</tr>
<tr>
<td>Group projects</td>
<td>Sydney pub. (11)</td>
<td>-</td>
<td>7</td>
<td>4</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>Sydney indep. (6)</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>Woll. Cath. (8)</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1.63</td>
</tr>
<tr>
<td></td>
<td>Woll. pub. (8)</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>1.75</td>
</tr>
<tr>
<td>Total (33)</td>
<td>2 (6%)</td>
<td>16 (48%)</td>
<td>15 (43%)</td>
<td>-</td>
<td>1.61</td>
</tr>
</tbody>
</table>
4.4.10 Resources for Learning

Facilitating student learning is an important aspect of teaching. A thoughtful selection and use of materials assist teachers in presenting any subject matter. Some of the many resources available to teachers were listed and teachers were asked to note how frequently they used the materials in maths teaching. Table 4.49 provides an account of the responses received.

Table 4.49: Teachers' Responses to the Question Which of the following do you use in maths teaching with your class?

<table>
<thead>
<tr>
<th>Resource material</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape recorder / CD player (29)</td>
<td>1 (3%)</td>
<td>8 (28%)</td>
<td>20 (69%)</td>
<td>0.34</td>
</tr>
<tr>
<td>Computer (34)</td>
<td>6 (18%)</td>
<td>25 (74%)</td>
<td>3 (9%)</td>
<td>1.09</td>
</tr>
<tr>
<td>CD ROM maths packages (33)</td>
<td>6 (18%)</td>
<td>22 (67%)</td>
<td>5 (15%)</td>
<td>1.03</td>
</tr>
<tr>
<td>TV set (32)</td>
<td>-</td>
<td>2 (6%)</td>
<td>30 (94%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Video-tape recorder (32)</td>
<td>1 (3%)</td>
<td>2 (6%)</td>
<td>29 (91%)</td>
<td>0.13</td>
</tr>
<tr>
<td>Worksheets (33)</td>
<td>19 (58%)</td>
<td>14 (42%)</td>
<td>-</td>
<td>1.58</td>
</tr>
<tr>
<td>Calculator (33)</td>
<td>12 (36%)</td>
<td>20 (61%)</td>
<td>1 (3%)</td>
<td>1.33</td>
</tr>
<tr>
<td>Class text (33)</td>
<td>18 (55%)</td>
<td>7 (21%)</td>
<td>8 (24%)</td>
<td>1.30</td>
</tr>
<tr>
<td>Maths models (33)</td>
<td>15 (45%)</td>
<td>17 (52%)</td>
<td>1 (3%)</td>
<td>1.42</td>
</tr>
<tr>
<td>Polyhedrons (30)</td>
<td>6 (20%)</td>
<td>20 (67%)</td>
<td>4 (13%)</td>
<td>1.07</td>
</tr>
<tr>
<td>Base 10 blocks (34)</td>
<td>17 (17%)</td>
<td>16 (47%)</td>
<td>1 (3%)</td>
<td>1.47</td>
</tr>
</tbody>
</table>

The responses often, sometimes and never were assigned values of 2, 1 and 0 respectively and the mean values were calculated for each of the resource materials.

The most popular resource material among the materials provided was worksheet (mean = 2.58). Base 10 blocks, maths models, calculator, class text,
computer, polyhedron and CD ROM packages were the materials, in order of preference that were used by the subjects of this study in their teaching of mathematics. Meanwhile, more than 90% of the teachers stated that they never used TV sets or Video-tape recorders for their teaching while about 70% of the participant teachers noted that they were not using tape recorders or CD players at all.

When the teachers were asked whether they were satisfied with the availability of resources in their schools for mathematics teaching, their responses were recorded in a 3-point Lykert-type scale. The responses very satisfied, satisfied and not satisfied were assigned values of 3, 2 and 1 respectively, and the mean values for each school were calculated. Table 4.50 provides this information.

<table>
<thead>
<tr>
<th>School</th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Not satisfied</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney public (12)</td>
<td>-</td>
<td>8</td>
<td>4</td>
<td>1.67</td>
</tr>
<tr>
<td>Sydney independent (6)</td>
<td>-</td>
<td>1</td>
<td>5</td>
<td>1.17</td>
</tr>
<tr>
<td>Wollongong Catholic (8)</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>1.75</td>
</tr>
<tr>
<td>Wollongong public (8)</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>2.50</td>
</tr>
<tr>
<td>Total (34)</td>
<td>4 (12%)</td>
<td>19 (56%)</td>
<td>11 (32%)</td>
<td>1.79</td>
</tr>
</tbody>
</table>

Table 4.50 reveals that, on average, the practising teachers of this study were not satisfied with the availability of resources in their schools as the mean value for the total participants was 1.78 which is below the value assigned to the response satisfied. However, 68% of the participant teachers were of the opinion that their schools supplied them with enough resource materials. On the basis of teachers perceptions, it seems that, among the four schools,
Question 7.3 of the Teacher Questionnaire asked the practising teachers to state the three most important maths teaching materials they used to teach primary mathematics. In response to this open-ended question a variety of materials were recorded and Table 4.51 lists these materials in order of frequency.

Table 4.51: Most important maths teaching materials

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Base 10 blocks</td>
<td>5</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>13 (52%)</td>
</tr>
<tr>
<td>Counters</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>10 (40%)</td>
</tr>
<tr>
<td>Concrete materials/ models/ blocks of all shapes</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>10 (40%)</td>
</tr>
<tr>
<td>Worksheets/activity sheets/ workbook</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>8 (32%)</td>
</tr>
<tr>
<td>Text/ K-6 Syllabus</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>7 (28%)</td>
</tr>
<tr>
<td>Measuring instruments</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>6 (24%)</td>
</tr>
<tr>
<td>Games</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>6 (24%)</td>
</tr>
<tr>
<td>Bundles &amp; left over</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>5 (20%)</td>
</tr>
<tr>
<td>(Chalk) board</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>4 (16%)</td>
</tr>
<tr>
<td>Computer</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Calculator</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Numerical cards</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2 (8%)</td>
</tr>
</tbody>
</table>

Table 4.51 reveals that Base 10 blocks, counters, maths models and worksheets were regarded as the most important teaching materials by the participant teachers. A similar result emerged from Question 7.1 of the Teacher Questionnaire, which indicated that worksheets, Base 10 blocks and maths models were regarded as the most popular resources. However, the response rate to Question 7.3 was only 74% while the response rate to Question 7.1 was
94%. This may be because this question was open-ended and was a repetition of Question 7.1 in a different form.

When teachers were asked to give reasons for their selection of those materials listed Table 4.51, most of them stated that they were hands-on. A complete list of these statements is:

- Hands-on and fun.
- Hands-on is imperative for the younger children. They need to see and discover for themselves.
- Kinder children need to have hands-on experiences to understand concepts.
- Kids need hands-on work.
- I believe in hands-on approach.
- The children are specially motivated and seem to learn more when it is hands-on or they are really involved in the process.
- Working with young children, it is vital to have a large range of hands-on, visual objects to use in association with teaching different concepts.
- They provide hands-on experience followed by worksheets to consolidate their learning.
- Hands-on activities and infants need concrete materials in every stage of learning.
- Children still need to have hands-on experience to understand concepts.
- They make maths fun.
- Children enjoy them.
- Kindy love learning through games.
- Children are exploring.
All these statements corroborate the perceptions that children participate actively in learning maths concepts.

Likewise, technology is considered an important aspect of mathematics learning today. Computers play a considerable role in the lives of individuals and in our society. Use of calculators and computers is also recommended in the primary curriculum of NSW schools (NSW Department of Education, 1989). Questions 7.5, 7.6, 7.7 and 7.8 of the Teacher Questionnaire asked about the use of computers in schools.

In particular, Question 7.5 asked about the availability of computers for the use of children in their classroom and in another room. Table 4.52 shows a summary of the number of computers available for children's use in each of the four schools under study.

<table>
<thead>
<tr>
<th></th>
<th>Sydney public</th>
<th>Sydney indep.</th>
<th>Wollong. Catholic</th>
<th>Wollong public</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of computers available in teacher's classroom</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Number of computers available in another room</td>
<td>5</td>
<td>20</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 4.52 reveals that Wollongong public school and Sydney independent schools were better resourced than Sydney public school and Wollongong Catholic school in relation to overall availability of computers.

When participant teachers were asked how often students had access to computers, in Question 7.6 of the Teacher Questionnaire, teachers from Sydney public school, Wollongong public school and from Wollongong Catholic school
reported that their children had access to computers daily in their classroom and once a week in computer lab. Sydney independent school children had access once a week in the computer room only. In all these four schools, children had timetable access to computers.

Question 7.7 of the Teacher Questionnaire asked them how they used computers in maths teaching. Most of them reported that they used computers when using a CD ROM maths package, mainly the Maths Made Easy package. They were of the opinion that these packages were a means to revise, drill, reinforce and consolidate the maths concepts learned. Children were encouraged to work through the Maths Made Easy package as the program was aligned with the expected outcomes.

Some of the participant teachers reported that they used computers to get spreadsheets for recording and graphing. Others mentioned the use of computer games and problem solving games as tools for self-learning. However, when the participant teachers were asked through Question 7.8 of the Teacher Questionnaire whether there was a sufficient variety if maths packages available, 80% of them contended that the variety of maths packages was insufficient.

In short, the preference for resource materials to support hands-on experiences show that the participant teachers of this study were much concerned about the active participation of their children in mathematics learning.

4.5 Summary of main findings

Part of the questionnaires was designed to elicit descriptive factual information about the student teacher and practising teacher populations themselves by asking about such things as age, gender, student status or professional position, current year level or professional qualifications, and employment experience or
teaching experience of the student teacher and practising teacher population. These factors were considered to be potentially relevant to their professional life. In view of this, a number of Chi Square tests were carried out and the statistically significant results are as follows:

**Mathematics background and training**

1. There was a significant difference between the age groups and the level of study of high school mathematics (chi square = 103.82, p = 0.0001).

**Emphasis on mathematics in preservice program**

2. There was a significant difference between the year levels of the student teachers and their opinions about the emphasis on mathematics in their preservice teacher education program (chi square = 13.49, p = 0.036).

**Adequacy of mathematics training in preservice**

3. There was a significant difference between the year levels of the student teachers and their perceptions about the adequacy of mathematics training in their preservice teacher education program (chi square = 13.51, p = 0.036).

**Nature of mathematics**

4. There was a significant difference in the beliefs of the student teachers and practising teachers that 'mathematics should be seen as a creative activity (chi square = 6.39, p = 0.041).
5 There was a significant difference in the beliefs of the student groups that 'mathematics should be seen as a creative activity (chi square = 23.51, p = 0.0006).

Mathematics curriculum in NSW

6 There was a significant difference in the beliefs of the student teachers and practising teachers on the belief statement that 'children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts' (chi square = 23.91, p = 0.0001).

There was also a significant difference in the beliefs of student teachers across the year levels, about the same belief statement (chi square = 16.15, p = 0.013).

7 There was a significant difference in the beliefs of the student teachers and practising teachers on the belief statement that 'too much emphasis is placed on mathematics in the NSW primary curriculum' (chi square = 7.95, p = 0.019).

There was also a significant difference in the beliefs of student teachers across the year levels, about the same belief statement (chi square = 20.21, p = 0.0025).

8 There was a significant difference in the beliefs of the student teachers and practising teachers on the belief statement that "the teacher should give tests to the children at least every week" (chi square = 9.95, p = 0.007).

There was also a significant difference in the beliefs of student teachers across the year levels, about the same belief statement (chi square = 36.89, p = 0.0001).
9 There was a significant difference in the beliefs of the student teachers and practising teachers on the belief statement that "the school should provide parents with enough information about what children are being taught" (chi square = 14.12, \( p = 0.001 \)).

10 There was a significant difference in the beliefs of the student teachers and practising teachers on the belief statement that "too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics" (chi square = 11.64, \( p = 0.003 \)).

11 There was a significant difference in the beliefs of student teachers across the year levels, on the belief statement that 'State-wide Basic Skills Tests are essential to monitor the children's progress' (chi square = 34.82, \( p = 0.0001 \)).

12 There was a significant difference in the beliefs of student teachers across the year levels, on the belief statement that 'problem solving instruction should emphasis on the process of problem solving more than on the product' (chi square = 16.40, \( p = 0.012 \)).

**Mathematics teaching strategies**

13 There was a significant difference between student teachers and practising teachers in the preferences to 'guided discovery' as a teaching strategy (chi square = 9.61, \( p = 0.008 \)).

14 There was a significant difference between student teachers and practising teachers in the preferences to 'problem solving' as a teaching strategy (chi square = 8.54, \( p = 0.018 \)).
15 There was a significant difference across the year levels of student teachers in the preferences to 'drill and practice' as a teaching strategy (chi square = 26.67, p = 0.0002).

16 There was a significant difference across the year levels of student teachers in the preferences to 'journal writing' as a teaching strategy (chi square = 21.55, p = 0.0015).

*Training for a competent mathematics teacher*

17 There was a significant difference between student teachers and practising teachers in the preferences to the kind of training on 'maths teaching methods -- integrating maths with other KLAs' (chi square = 8.81, p = 0.012).

18 There was a significant difference across the year levels of student teachers in the preferences to the kind of training on 'maths teaching methods -- integrating maths with other KLAs' (chi square = 14.69, p = 0.023).

19 There was a significant difference across the year levels of student teachers in the preferences to the kind of training on 'psychological basis for teaching of maths' (chi square = 12.81, p = 0.046).

**4.6 Conclusion**

The analysis of the questionnaire data included the analysis of the beliefs held by practicing teachers and student teachers about the nature of mathematics, mathematics teaching and mathematics learning, and many other related factors.

This analysis of questionnaire data also provided the basis for the analysis of qualitative data received through semi-structured interviews. The following chapter will show the development of the interpretation of the questionnaire data in a meaningful way through the analysis of the qualitative data.
5.1 Introduction

The aim of this chapter is to analyse the qualitative data obtained from the semi-structured interviews. This analysis has enriched the interpretation of the questionnaire data in a meaningful way as the interview questions probed the same issues as the survey questions, allowing for deeper insights and perceptions to be aired. In Chapter 6, the findings from the study are compared and contrasted with policy and practice discussed in the literature review chapter.

5.2 Background and setting

Of the 34 participant practising teachers in this study, twelve teachers were selected as a purposive sample for semi-structured interview. SP1, SP2 and SP3 were from the Sydney public school while SI1, SI2 and SI3 were from the Sydney independent school. WP1, WP2 and WP3 were selected from the Wollongong public school, while WC1, WC2 and WC3 were from the Wollongong Catholic school. (Pseudonyms have been used.)

Among the twelve participant practising teachers of this purposive sample, SP1 and WP1 were casual teachers each with 3 years of teaching experience. SI1 had only 2 years of teaching experience and was a Special Education Teacher with a B Ed in Special Education. SI2 and WC1 were full-time class teachers
each with 6 years of teaching experience while SP2 was also a full-time class teacher with 9 years of teaching experience. WC2, SI3, SP3, WC3, WP2 and WP3 had extensive teaching experience of 18 years or more. Of them, WC2, WP2 and WP3 were full-time class teachers while WC3, SP3 and SI3 held senior administrative positions in their schools as well as being full-time class teachers.

5.3 An overview of the analytical process

The analytical process employed a number of steps. These main analytic steps could be listed as follows:

1. To use the research questions to construct the initial basic categories.

2. To transcribe all the recorded semi-structured interviews.

3. To code the transcripts and to record them under the initial basic categories.

4. To identify a number of sub-categories for each of the initial categories as they emerged from the interview data.

5. To code interview data according to the sub-categories. During this process, these categories were modified and developed, for example, by eliminating redundancies, clustering units of related meaning, creating sub-categories, etc.

6. To identify general themes across both the quantitative and qualitative data.

7. To contextualise the themes and to compose a summary to capture the essence of the phenomena being studied.
5.4 Construction of coding categories

Construction of coding categories was an interwoven process that resulted from different aspects of this study. Initially, six basic themes came from the research questions, and with these six themes and related initial categories in mind, the questionnaires and the semi-structured interview schedules were designed. The six initial significant themes identified for the construction of categories for coding of the interview data were:

1. Beliefs about the nature of mathematics (M)
2. Beliefs about mathematics education, mathematics teaching and mathematics learning (E)
3. Teacher perceptions of influences on beliefs about classroom practice (I)
4. Teacher perceptions about external factors preventing change (F)
5. Student teachers’ perceptions about the preservice program (P)
6. Perceptions about the NSW curriculum and policy (C)

The initial six themes were also prominent in the data. When the semi-structured interview data was coded, categories and sub-categories that were grounded in the situation also emerged. These categories and sub-categories were then modified and added to and data regrouped several times. Some practising teachers and student teachers talked about many things in one sentence and this caused overlapping of categories. However, they were categorised according to the emphasis given by the interview and through the self-determination of the researcher. Eventually, the semi-structured interview data analysis gave rise to the following categories and sub-categories:
1. Beliefs about the nature of mathematics (M):
   (i) Functional (MF)
       (a) Important aspect in everyday life (MFL)
       (b) Important aspect in occupations and professions (MFO)
   (ii) Means to understand the real world (MU)
   (iii) Powerful tool for solving problems (MP)

2. Beliefs about mathematics education, mathematics teaching and mathematics learning (E)
   (i) Activity-based (EA)
       (a) Discovery (EAD)
       (b) Fun and enjoyment (EAF)
       (c) Real life relevance (EAR)
       (d) Group work (EAG)
       (e) Visualisation (EAV)
       (f) Understanding (EAU)
       (g) Textbook work (EAT)
   (ii) Drill and practice / rote learning (ED)
   (iii) Problem-based (EP)

3. Teachers’ perceptions of influences on beliefs about classroom practices (I)
   (i) Own teaching experience (IE)
       (a) Success (IES)
       (b) Children’s preference (IEP)
   (ii) Own schooling (IS)
   (iii) Family background (IF)
   (iv) Preservice (IP)
   (v) Inservice (II)
   (vi) School culture/structure/colleagues (IC)
   (vii) Reflective practice
4. Teacher perceptions about external factors preventing change (F)
   (i) Finance (FF)
   (ii) Time (FT)
   (iii) Classroom culture (FC)
       (a) Class size (FCS)
       (b) Ability levels of children (FCA)
       (c) Behaviour of children (FCB)
   (iv) School policy

5. Student teachers' perceptions about the preservice programs (P)
   (i) Enthusiasm (PE)
   (ii) Strengths (PS)
   (iii) Weaknesses (PW)

6 Perceptions about the NSW curriculum and policy (C)
   (i) Syllabus documents (CS)
   (ii) Integration (CI)
   (iii) Calculators (CC)
   (iv) Problem solving (CP)
   (v) Parent as teacher aid (CA)
   (vi) Basic Skills Test (CB)

The participant practising teachers and student teachers were identified according to their school and year level of study:

1 Teachers from the Sydney public school (SP): SP1, SP2 & SP3
2 Teachers from the Sydney independent school (SI): SI1, SI2 & SI3
3 Teachers from the Wollongong Catholic school (WC): WC1, WC2, & WC3
4 Teachers from the Wollongong public school (WP): WP1, WP2 & WP3
5 First Year Student Teachers (S1): S11, S12 & S13
6 Second Year Student Teachers (S2): S21, S22 & S23
7 Third Year Student Teachers (S3): S31, S32 & S33
8 Fourth Year Student Teachers (S4): S41, S42 & S43
All coded units of transcribed interview data were then organized into their various categories to provide a basis for writing summaries about the perceptions of student teachers and practising teachers in relation to primary mathematics.

5.5 Beliefs, attitudes and perceptions about mathematics and mathematics education

As cited in the 'Literature Review' chapter of this study, practising teachers and student teachers hold beliefs about the nature and the learning and teaching of mathematics. Eventually, these beliefs do influence their attitudes to teaching mathematics and their overall perceptions of mathematics learning and teaching in the classroom.

In general, it was evident from the 'Analysis of Questionnaire Data' that the participant student teachers and practising teachers of this study believed that mathematics should be seen as 'a practical way of coping with everyday life', 'a stepping stone to higher education', 'a precise discipline for training of the mind', 'a powerful tool for solving problems' and 'a creative activity'.

In order to interpret these belief statements more clearly, the participant teachers and student teachers in the semi-structured interview were questioned on the beliefs they held about why mathematics should be taught. Responses to these questions reflected similar beliefs about the nature of mathematics as depicted in the analysis of the questionnaire data and added depth and detail to the understanding of their beliefs.

These beliefs are discussed under the categories and sub-categories mentioned before. The discussion of said categories and sub-categories includes the codes of every teacher and every student who made a response, which was coded in that category. This is followed by some examples to illustrate these categories.
5.5.1 Beliefs about the nature of mathematics (M)

(i) Functional (MF)
All practising teachers and student teachers who were interviewed described the nature of mathematics as functional. The functional nature is referred to as an important aspect in everyday life and as an important aspect in occupations and professions.

(a) Important aspect in everyday life (MFL)
While describing the functional nature of mathematics, all practising teachers and student teachers valued mathematics as an important aspect in everyday life. This is evidenced in SP3’s statement.

I believe its in everyday life, everything we do, revolve around mathematics. When we go shopping we need maths. When we calculate distances when we are traveling, we need maths. There aren’t many things we do where we don’t need maths. Every bill we pay, we need to be able to calculate whether we are being ripped off or whether its’ actual...

(SP3 -- 20/06/00 – MFL)

While perceiving mathematics as an essential part of our life, WP3 emphasised mathematics skills as life skills in his comment,

...For everyone in this society, you need to have a grasp of reasonable amount of mathematics skills to survive in the community... not only to survive but also to figure in the community your own funds, your own lifestyle. As you become an adult, it’s important.... even school kids should know and must know mathematics for their own good and it’s important in our society.

(WP3 – 18/10/00 – MFL)

WP2 strongly emphasised this view,

...mathematics is now... not just all sums...not just learning a process but learning how to use it...

(WP2 – 12/09/00 – MFL)
A third year student teacher revealed a similar view where mathematics is seen as life skills. This appeared as,

I think it's important because maths is everywhere. We use maths in everything we do... I think certain things we do in life need mathematics skills and I think it's pretty important that way that we learn life skills from mathematics.

(S32 – 09/08/00 – MFL)

(b) Important aspect in occupations and professions (MFO)

Among the interviewees, only three practising teachers, SI1, SI2, WP1, and one student teacher, S41 felt that the functional nature of mathematics was an important aspect not only in everyday life but also in most occupations and professions. WP1 explained this as,

Nowadays with computer technology, you just need maths, because if you can’t add or subtract, multiply or divide, even the basic maths, if you can’t do that, generally you won’t be able to get a good job. You need more maths just to keep up with technology

(WP1 – 06/09/00 – MFO)

SP2, in turn, supported this belief by her comment,

Mathematics should be taught so that ultimately people can function effectively in society. This means that not only can they function in various occupations and professions, but also in everyday life. Maths exist all around us and everywhere we turn, whether to do with driving to work or whether it's to do with shopping or even hobbies - everything has to do maths, ultimately...

(SP2 – 06/06/00 – MFO)

The functional nature of mathematics as an important aspect in everyday life and also as an important aspect in occupations and professions, was also revealed by a fourth year student teacher as,
...They are going to need it outside school, in their work... They need it for every thing even going shopping, yeah, basically.  
(S41 – 08/08/00 – MFO)

(ii) Means to understand real world (MU)

Three practising teachers, SI3, WC1 and WC3 mentioned mathematics as a means to understand the real world. Among the student teachers, only one from 1st year and another from third year commented on it. While admitting the importance of basic operations to cope with everyday life, WC1 claimed the importance of understanding real world as,

I believe that maths should be taught in the sense that it gives an understanding of how things work in our world...  
(WC1 – 27/06/00 – MU)

S11 and S33 also appeared to hold the same belief together with the functional nature of mathematics, where one stated,

I think... it's sort of "why things should, why things work out" and sort of like working out numbers – number is pretty an important thing in our society – so it's a kind of just a... basic skills that everyone should need to be taught...  
(S11 – 13/06/00 – MU)

(iii) Powerful tool for solving problems (MP)

Problem solving nature of mathematics was considered as a powerful tool by two practising teachers and three student teachers. SI1 valued problem solving by incorporating it with the functional nature. She said,

We use mathematics in so many things we do – not just shopping – many other things. We think a lot in numbers... We think in terms of problem solving, so it's a very essential part of life...  
(SI1 – 22/08/00 – MP)

While emphasising mathematics as a powerful tool for problem solving, SI3 probably summed up many of those beliefs that practising teachers of this study held about the nature and value of mathematics by the statement,
I think maths enters into a lot of things in everyday life. I think it's interesting to be able to discover why things work and be involved in a lot of those processes. I think also that to be able to think mathematically is a special style of thinking. Perhaps, there's a lot more problem solving...

(SI3 – 07/06/00 – MP)

It is also notable that SI3 was the only one who described a problem solving approach when asked for a typical lesson, as recorded in the previous chapter.

Similar to SI1 and SI3, the three student teachers, S11, S21 and S33 emphasised the value of mathematics in relation to problem solving abilities. One of them said,

I believe it gives problem solving abilities, so ... they can put it in contexts if they can solve the problem in maths so then they can solve the problems in other things and also that context of maths in the world...

(S23 – 13/09/00 – MP)

To summarise, interviewees from both practising teachers and student teachers in the sample of this study, valued mathematics as an essential part of life and perceived the functional nature of mathematics while some of them saw it as a means to understand the real world and some were strong advocates of its problem solving nature.

5.5.2 Beliefs about Mathematics education, mathematics teaching and mathematics learning (E)

The participant practising teachers and student teachers, who were interviewed in this study, expressed their beliefs about how children learn mathematics in a number of ways. Accordingly, they suggested different approaches to teaching of mathematics, which incorporate their beliefs.
(i) Activity-based (EA)

The overwhelming theme of beliefs about mathematics education, mathematics teaching and mathematics learning was the importance of activities. While all twenty-four participants interviewed acknowledged that children learn through hands-on activities as one of the ways of learning, twenty-one of them described these activities with reference to concrete materials, although SP1, WP2 and S12 did not refer to materials. A variety of different ways of teaching / learning through activities was mentioned during the interviews which are discussed in detail below.

(a) Discovery (EAD)

Seven practising teachers, SP1, SP3, SI1, SI3, WC2, WP1 and WP3 and two student teachers, S21 and S41 advocated discovery learning as one of the activity based learning methods. Among them, all insisted on the use of concrete materials, except SP1.

WC2 believed that 'children need to discover themselves using concrete materials, how numbers work, how things work and relate to each other'. She was of the opinion that mathematics involved difficult concepts for the majority of children and they were able to remember what they discovered hands-on, using concrete materials. This is evidenced by the statement,

There are some children who are very, very bright and they are going to get it regardless. But for the majority of children, maths is a difficult concept, but if it's explained to them and they can discover and they can put their hands on things and work it out themselves, they are going to always remember that they have to learn by seeing, by experimenting, by discovering...

(WC2 – 16/08/00 – EAD)

SP3 also supported WC2's belief about the importance of activity-based discovery learning in retaining knowledge, by the comment,
...The younger they are, the more they need to manipulate materials and discover for themselves and learn. The more they discover, the more lasting that’s going to be. They will remember that rather than what they have been told...

(SP3 – 20/06/00 – EAD)

However, a problem with this approach is the lack of an appropriate variety of concrete materials in schools. One Wollongong teacher described how she managed to overcome this problem:

A lot of things... Yes, I have made myself a lot of things. From my own children at home, like toys and things, counters and things... I have brought them along, because unfortunately we don’t have a great deal in the school. We are very limited in resources. They are trying very hard to get more, but... and then I suppose there are lots of things. I remember collecting shells from the wharf side, rocks and pebbles, and all sort of things, just to help them with their maths and their counting and in their numeration and things like that...

(WC2 – 16/08/00 – EAD)

One of the two student teachers who were strong advocates of discovery learning said,

I think they learn through experience and experimentation. So, if they can see a purpose for using it, and if they’ve used it before, I think that’s good, and if they can experiment how to use something so rather than doing sum on the board or something they could do a practical means for using it.

(S21 – 05/09/00 – EAD)

(b) Fun and enjoyment (EAF)

Six practising teachers – SP1, SP2, SI1, SI2, WP1 and WP2 -- and four student teachers – two from 1st year, one from 2nd year and one from 4th year – felt that it was the duty of teachers to incorporate their teaching strategies with fun and enjoyment activities.
SI1 reflected this belief when she commented on what she perceived as an emphasis on abstract mathematics as,

I think that often we just emphasise numbers and abstract symbols and we give the children worksheets to work on with lots of operations and lots of pluses and minuses and time tables, but not so much the opportunity to play with the objects and also mathematical games – games that are based on mathematical concepts so that they get fun and enjoyment, I think they are essential throughout schooling. They help a lot.

(SI1 -- 22/08/00 -- EAF)

This perception was also supported by SP2 when she emphasized her belief in the importance of concrete materials:

I also believe that concrete materials play an extremely important role in learning maths as well and we can provide for that area by having fun activities. For example, if you are teaching a topic, instead of a basic worksheet, turn it into a game within a group, and so on.

(SP2 -- 06/06/00 -- EAF)

SI2 and WP1 talked of the activities that children liked to do and explained how they had incorporated different strategies to make the children enjoy mathematics. SI2 reflected her belief with reference to kindergarten children,

We have a lot of different toys that the children use, construction toys or counters or blocks. They have a lot of those available for their use... Children, especially love making towers and learning all of the maths ideas that come from construction towers. They really enjoy maths time. It's a fun time for them in Kindergarten.

(SI2 -- 02/08/00 -- EAF)

WP2 also claimed the necessity to make learning interesting especially with younger children.

...Yeah... Usually it was just all paper work, just doing sums and now it's getting kids to do things and group works really enjoyable. Kids love doing those things...

(WP2 -- 12/09/00 -- EAF)
Further, a first year student teacher saw the importance of fun activities to motivate learning by the assertion,

I think by making it fun, not just sitting in the same position everyday, same time, writing the problem on the board and solving them individually... I think a bit of group work is necessary... Teacher needs to find out where individual students are and how individual students are coping with mathematics... the people that need more help... find out what motivates children to be able to learn mathematics to make interesting and maintain their interests, otherwise it's boring.

(S12 -- 14/06/00 – EAF)

(c) Real life relevance (EAR)

Only two practising teachers, SP3 and WP1, and four student teachers, two from 3rd year and two from 4th year, referred to the importance of real life relevance in their teaching/learning activities.

Real life relevance was central to WP1’s beliefs about activity-based learning. Her beliefs firmly supported the learning of everyday life activities where she claimed that ‘Children learn better if they can see a purpose to why maths is being taught’. WP1 illustrated her belief with an example:

... If you can relate it to everyday life, they say, “Okay, I’ll learn this ‘cause I see why I need to learn this...You’re doing a topic and it might be boring and if you don’t let them do hands-on or relate it to everyday life, they’ve a kind of go in one ear and out the other and they are not that excited about it... and they learn it just to pass a test or something. I find that children, if you’re doing something with shapes and measurements, you’ve got to get the measurement equipment out, you’ve got to get the shapes out. If you’re doing numeration, you need to go to the store to add and subtract and multiply, relate it to every day things so that kids can understand why it’s important. Otherwise, if they don’t see any use of it, they don’t try.

(WP1 -- 06/09/00 – EAR)
Two student teachers from third year and another two student teachers from fourth year also perceived the importance of the real life relevance in children's learning activities. An example can be shown by the statement,

I think that children are learning in so many different ways, what works for one may not work with another. However, I think that in the early stages, it's particularly important to have the use of concrete materials and also that's important, when children are learning mathematical concepts, that they're related to their everyday life so that they can see the relevance of it. ... Why it's necessary to be taught... for their own benefits... for their own capacity to function in day to day life with the maths that they're learning.

(S43 -- 11/08/00 -- EAR)

(d) Group work
Activity-based learning with group work as its focus was mentioned by four practising teachers and two student teachers. SP2, WP1, WP2 & WP3 disclosed that they used group activities in their teaching.

SP2 saw the importance of ability grouping to cater for individual differences. She claimed,

My beliefs on that would be that children learn at their own pace and individual differences need to be catered for and hence we need to have different ability groups within the room... Those beliefs apply to all the classes – all the grades in primary... I would do just as much concrete material work and group work and so on...

(SP2 – 06/06/00 – EAG)

However, WP2 appeared to believe in the use of mixed groups in his teaching. Although he had students with varying ability levels, WP2 used to have them in mixed groups rather than having them in ability groups. WP2 justified his belief by the statement,
I have groups, sort of all around the class with a mixture of kids in each group. Rather than all the brains in one group and all the kids that need help in another, I ask the kids that are good ones to be the professors and I ask them to help the kids that needed the help. That way they are being taught on a peer basis. Not just sitting there and acting like vegetables, they feel... they like maths a lot more...

(WP2 -- 12/09/00 – EAG)

However, the two student teachers S12 and S22 valued group activities for a variety of simultaneous activities. S22 described the efficiency of group learning activities, by giving an example,

...Probably group work and activities and trying to get if possible like parent helpers to come in and do rotation work where one group might be doing something en masse and they are using spring balance and another group might be doing something on length and they've got metre rulers and them are measuring things... I think, very, very hands-on. So, give them all the maths equipments and set their task to go out and use these equipments...

(S22 – 25/08/00 – EAG)

(e) Visualisation (EAV)

Only two practising teachers (SI1 & WC1) and only one (S31) referred to activity-based learning with focus on visualisation of the concept as important. Accordingly, facilitating students to visualise the concepts to have a base knowledge before moving into abstract thinking was central to SI1's beliefs on teaching and learning of mathematics. This belief can be evidenced by the comment,

I believe that mathematics should be taught with a lot of practical stuff – a lot of hands-on concrete objects so that the students can visualise the concept and not go into abstract thinking before they have a base of knowledge. A really stable and thorough base of knowledge with concrete materials and the objects that they can use...

(SI1 – 22/08/00 – EAV)
WC1 also reflected a similar view by the statement,

To teach primary mathematics, especially being a kindergarten teacher, I use a lot of hands-on materials. The children don’t understand unless they see it. They need to see the visual aspects of the concept that you are trying to teach...

(WC1 – 27/06/00 – EAV)

(f) Understanding (EAU)

Among the 24 participants in this study, only two practising teachers made explicit that the teaching and learning of mathematics should be aimed at ‘understanding the concept’ as the main focus. Both of these discussed this aim in the context of the use of activities and concrete materials No reference on this particular aspect was made by the student teachers.

WC3 clearly stated that her focus was on understanding, while describing activity-based teaching as his preferable way of teaching. He emphasised understanding as important prior to extension activities.

I found out that the probable best way, through experience, is hands-on methods using concrete materials, specially with the younger children or even with the upper primary children who are experiencing problems in understanding the concepts. It just gives them a chance... to get a feel for the concepts, they need to understand. You can use a variety of techniques whether it’s extending their mind through computer software or through extension activities...

(WC3 – 21/06/00 – EAU)

WC1’s belief about a hands-on approach for understanding was of a similar nature to WC3’s. WC1 was of the strong opinion that teaching should help children understand the concept taught which was possible through a hands-on approach with the use of concrete materials. According to her, children do not understand a concept unless they see it. Thus, understanding and visualisation are two aspects interconnected inseparably.
Learning through textbook activities was mentioned by only one practising teacher and by only one student teacher as a way of learning mathematics. S32 considered textbook work as a ‘back up’ to the learning through hands-on activities while SP2 strongly believed that learning from a textbook could also be enjoyable if it was supplemented with hands-on activities.

While he was aware of textbook work, S32 stated that his negative experiences from his primary schooling had made him think of hands-on activities as the best way of learning. He said,

I probably think, this is because of my own negative things I got from primary school... so, I would probably think they learn the best from using hands-on equipment. Like, it's fair enough to use textbooks and stuff like that as a back up, but I certainly think their needs to be teacher instruction. Probably peer collaboration, group work that sort of thing and I think there has to be individual learning and that can be done using the textbook, perhaps.

(S32 – 09/08/00 – EAT)

However, SP2 acknowledged that learning from the textbook was also enjoyable to her students, citing two reasons. She elaborated this belief as,

I think that they enjoy the textbook that we have got as well – “Step Ahead with Maths”... We use it in a limited kind of way and we use it in a balanced way, so it’s supplemented by hands-on rather than games and group work, and also the textbook that we are using now is much more interesting than the textbook that I used at school, and it calls for concrete materials. Although you might have the children at the desk with pen, pencil and textbook, they're also using the concrete materials with the textbook...

(SP2 – 06/06/00 – EAT)

SP2’s belief on textbook work also describes a way of designing mathematics textbooks.
(ii) Drill and practice / rote learning (ED)

Reference to drill and practice or rote learning was made by three practising teachers – SP3, SI3 & WP2, and by three student teachers – S12, S23 & S33. Although all these six participants were strong advocates of activity-based learning, they saw the value of drill and practice in some particular instances.

While emphasizing meaningful activities, S33 admitted, that ‘Probably, drill and practice comes into it sometimes...’ (S33 – 04/10/00 – ED). S23 held a similar view and explained this with an example,

... Things like times table... I think, really it has to be drill because I know that we drilled our times tables that’s really the only way I remembered it. I think that if the teacher can make it interesting, not just open the textbook to this page and do that, I think that would have really big effect on actually how they learn it. Because I think it’s important that they should retain it in their memory and if it’s boring then they’ll just do it to get it done, sort of push it away then.

(S23 – 13/09/00 – ED)

However, there is more ambiguity here. Although she mentioned that drill and practice should be interesting, S23 did not mention anything about how to make it interesting. While WP2 felt that it was better to do practical activities, he explained how he used drill and practice together with practical activities to make the learning interesting.

Usually I was taught by practice and drill. Better is by doing practical activities like they should go out and using the things, picking up things, lifting things, weighing things and measuring things, which is great. But, I find now is that I need both. I need to have some basic drill like basic sort of just going over it quite often and the activities as well, not just one or the other.

(WP2 – 12/09/00 – ED)

However, WP2 preferred hands-on activities to drill and practice, where he commented,

I enjoy maths, yeah. It’s so diverse now. Usually, it was just all paper work, just doing sums and now it’s getting kids to do things and group work’s really enjoyable. Kids love doing those things –
things like floating in the tank, weighing things, sliding things or checking things. Yeah, it's hands-on...

(WP2 - 12/09/00 - EACF)

On the other hand, SP3 argues for the place of rote learning,

...but I believe there is a place for rote learning though. There are some facts that must be learnt all the time, but makes the foundation – the basis for the mathematics knowledge and from then only they use that in whatever they are doing...

(SP3 - 20/06/00 - ED)

(iii) Problem-based (EP)

Among the 24 interviewees, only SI3 and WC3 referred to problem-based learning and teaching as one of their approaches. WC3 acknowledged that he did 'quite a bit of problem solving with the children'. SI3 was a strong advocate of problem-based teaching and learning. SI3's belief about the learning and teaching was congruent with her stated belief about the nature of mathematics.

As mentioned before, she valued mathematics as a special style of thinking involving a lot of logic and problem solving.

SI3 summed up her beliefs about how children learn mathematics by the statement,

I think that they learn by doing. They learn by experience. There are some things, I guess, that they need to learn by rote... I think that they learn when they are ready and when they have had the appropriate experience. They understand the concept involved and learning happens and if a teacher is lucky enough to be able to capitalize on that experience, that's wonderful...

(SI3 - 07/06/00 - EA)

Although this statement does not advocate problem-based learning as such, it was evident that she had great concern for problem-based learning, from her comment when she described the process involved in problem-based learning:
To set up the situation, perhaps in the classroom, or outdoors, so that they can discover for themselves. I guess sometimes it's contrived because you want them to discover some particular thing, so if you set up the problem, or you set up the situation, pose the question and then provide them with the materials they can experiment with and make a discovery...

(SI3 – 07/06/00 – EP)

In summary, the participants in this study had a variety of beliefs on how children best learned mathematics and how it should be taught. All 24 interviewees believed strongly in activity-based teaching and learning but with different foci such as on discovery, fun and excitement, real life relevance, etc. Six of them acknowledged a place for drill and practice or rote learning while only one practising teacher and another student teacher made explicit reference to the importance of problem-based learning. There was no clear pattern of difference between the teachers and the student teachers although the teachers had the experience to discuss their beliefs about mathematics from the point of view of their perceptions of classroom practice.

5.5.3 Teachers' perceptions of influences on beliefs about classroom practices (I)

As seen in the 'Literature Review' of this study, teacher change is represented as an important factor in implementing new initiatives and policies of an education system. In that case, participant teachers interviewed in this study, in general, seemed to believe that change is important.

The rationale for the need for change and the importance of change were made explicit during the interview with them. This can be evidenced by the comment made by WP3 that,

Like maths teachers we change our view in line with current developments, especially in technology... Obviously, there are a lot of aspects in teaching maths that are coming forward in modern society and we have to continually update and look into new and better methods of teaching maths...

(WP318/10/00 – I)
A belief in the importance of change emerged strongly from WP1's and SI1's interview where they stated,

...So I find I change all the time as I'm getting to be a better teacher. My view changes of how to teach things and how to do things... and there's something you've got to teach... As you get more experience, your views change.

(WP1 -- 06/09/00 -- I)

'... I haven't been teaching for a long time, but I guess we are changing the way we do things all the time. I guess if we stagnated, we wouldn't be where we are...

(SI1 22/08/00 -- I)

As stated in Chapter 1 of this study, 'contribution to the reconceptualisation of teacher education programs' and 'development of teachers' awareness of belief system' are the two main foci of this study. In view of this, it is important to look at the influences that were inherent in forming those beliefs.

(i) Own teaching experience (IE)

All twelve teachers interviewed in this study stated that they had developed their beliefs on teaching mathematics through their own experience as mathematics teachers. There was no other factor mentioned by every teacher. Some of the interviewees especially mentioned the influence of success, and children's preferences.

(a) Success (IES)

Three practising teachers SP3, WC3 and WP3 made reference to the success in their teaching as the influence on their practice. WP3, with his extensive experience as a teacher, claimed that success in achieving the expected outcomes had influenced the development of his teaching strategies. He said,

I find that if the children are achieving the outcomes that I have established for them, well obviously those ways are going to suit my teaching and their way of learning that when you pick up these
experiences, or pick up what is working with things that are working for you, definitely you will use those choices...

(WP3 – 18/10/00 – IES)

SP3 showed evidence that her beliefs on teaching and learning of mathematics had changed over the years she has been a teacher. It is inferred that she had learnt these from the success of her own teaching experience. SP3 said,

I think I had strong beliefs in rote learning. Learn the facts, learn what we can do with numbers, learn the formula and then you can apply that to situations. But for some children, that will never happen unless they figure it out from the beginning, because of their conceptual knowledge, then they are never going to get it. They can’t learn from a formula and then apply it because they don’t know when or how to apply it, so they must learn from the beginning how these concepts work...

(SP3 – 20/06/00 – IES)

This is also evidenced by the statement,

When the children are not successful in learning through ‘chalk and talk’... then you know that you have to revert to concrete materials so that the children can actually experience what is happening, rather than relying on being told that this is a fact...

(SP3 – 20/06/00 -- IES)

These statements imply that SP3 had changed her traditional beliefs through success in her experience as a teacher and had moved towards a contemporary, constructivist view of mathematics teaching and learning.

WC3 claimed that he was an advocate for concrete materials even early in his career. This can be evidenced by the statement,

Definitely, it’s through my own experience. When I first started my teaching... the use of concrete materials wasn’t as dominant as it is now and also specially teaching the younger children, Year 1 and Year 2... Earlier in my career I found that concrete material was definitely the way to go for the children who had difficulties and that comes through too to the older children at the moment...

(WC3 – 21/06/00 – IES)
WC3 also acknowledged that his views had changed depending on the success of the methods used. He strongly believed that the success of a method had provided motivation and feedback on the effectiveness of that particular method. While describing how he built up his belief system throughout his career, WC3 elaborated on the value of success.

I guess it's pretty much through success. If I can see something has worked, I'll take it on board and I'll keep working at it and keep trying to improve that method whereas if something doesn't work it confuses the children, which sometimes it does specially at this age. You know, I pretty much put it at the back of the cupboard and forget about it. It's pretty much in maths if you succeed, try, try again. If it doesn't succeed, well may be... forget about that one.

(WC3 – 21/06/00 – IES)

(b) Children's preferences (IEP)

Only two practising teachers particularly mentioned about the influence of children’s preference. SP1 acknowledged that the children were central to teachers' beliefs. When questioned about the experiences that had led her to choose her teaching strategies, she implied that it was the children’s preferences, by the comment that ‘...the kids always cringe when we do text work...’(SP1 – 23/08/00 – IEP)

WP1 talked of the activities children liked to do and explained how she had incorporated different strategies to make the children enjoy mathematics:

They enjoy working with things and going outside and measuring things or weighing things – they like hands-on mathematics... but, I like to go to introduction, go through it, do some challenges, extra sheets for challenging students, test to see if they review the concept. If there’s anything I can use to stimulate them, I will use it. I used to like using chalkboard but the kids don’t like that... More excited about sitting in groups and doing activities. Nowadays have more fun with it and enjoy it.

(WP1 – 06/09/00 – IEP)
(ii) Own schooling (IS)

SP2, SI1, WC2 and WP1 acknowledged the influence of their own schooling experiences on their teaching practice. SI1 said that the positive experience that she had in her early schooling influenced her way of teaching. She remembered her own schooling as,

Yes, I did... I liked maths and I had a teacher who has used quite a bit of concrete materials, so I enjoyed maths in primary...

(SI1 – 22/08/00 – IS)

However, the negative experience in their own schooling influenced the current practice of the three teachers SP2, WC2 and WP1. Particularly, it seemed that WC2’s beliefs on teaching mathematics might have stemmed from her early schooling experiences. While remembering those experiences, she exclaimed, ‘...So no, it was very horrendous!’ (WC2 – 16/08/00 – WC2). She went on to explain why it was horrendous:

...No, I never enjoyed maths in primary school. I can remember sitting in rows, not having anything explained to me, the brighter children who discovered easily you were fine. If you were a little slower, you were punished for asking again...

(WC2 – 16/08/00 – IE)

Moreover, WC2 revealed how her schooling experiences had led her to choose her ways of teaching. The scar resulting from her school experience was well reflected when she said,

...I suppose from my own childhood experience with not ever understanding mathematics, and the teachers... the teachers who were too busy to really explain... may be they didn’t understand themselves and may be they only knew the direct process of it... I suppose they need to be given lots and lots of experience and practice for themselves to discover, because of my dreadful experiences...

(WC2 – 16/08/00 – IS)

Similarly, WP1 admired the importance of repeating work, from her own schooling, when she claimed,
... A little bit of repeating is good, that’s from my own personal use because I wasn’t taught that way, which would have helped me out...

(WP1 – 06/09/00 – IS)

(iii) Family background (IF)
Only one teacher mentioned specific family influence on her teaching. This was SI2. As her mother was a High School teacher and also a lecturer in mathematics, SP2 was able to get support from her in learning to teach mathematics when she was at university and also was able to get ideas and resources while she was teaching.

Although there were other external factors such as preservice, inservice and school culture that had influenced her present teaching, SP2 valued the advice and direction from her Mum as the most influential one. When questioned about to whom she went in need of some advice in mathematics, she replied,

I generally go to my Mum to get advice, because I feel she has a lot of experience in many different aspects of mathematics, not just because of her profession being a lecturer, but also because of her experience as a teacher... and I guess, although with other subjects I would tend to ask the people here, with maths, I don’t. I ask my Mum because I feel that she got the best knowledge.

(SP2 – 06/06/00 – IF)

(iv) Preservice (IP)
Only SP2 and WC2 mentioned preservice as an influence on their beliefs. WC2 recognised that the Teachers College made her perceive a great deal about mathematics that she ‘never ever knew’.

Although her Mum was a High School teacher, mathematics was not an interesting subject to SP2 until she entered university. But, she admitted that the preservice at the university was a turning point in relation to her perception about mathematics teaching and learning. SP2 recalled how it happened by the statement,
...I didn’t enjoy it in Primary. I didn’t enjoy it in High School. Then I started to enjoy at Uni, because suddenly I discovered that there was a whole new work of concrete materials...

(SP2 – 06/06/00 – IP)

(v) Inservice (II)

Only five teachers SP1, SP2, SI3, WC2 and WP2 accepted that inservice was one of the influential factors in forming their beliefs about mathematics, mathematics learning and mathematics teaching.

SP2 indicated how inservicing influenced her classroom practice:

...In my early years of teaching, especially the first three or four years, I attended a lot of training courses and inservices and they led me to choose these different ways...

(SP2 – 06/06/00 – II)

When questioned about the experiences that led him to choose his ways of teaching, WP2 made explicit the importance of inservicing.

...Inservicing over the years and just trying it and doing it and enjoying it... I didn’t enjoy mathematics that much when I was at school but I enjoy teaching it. It’s my favourite subject now...

(WP2 – 12/09/00 – II)

Furthermore, WP2 compared his initial teaching to his present practice in the comment,

...When I first went teaching out in the country, the old principal would come in and say, “Right, here’s the drill. Tables every morning, drill these, drill these, do thousands of mentals everyday”... Mostly pushing for multiplication and basic operations. That was a big push. Now, mathematics has broadened right out... a lot more space and measurement activities, which is more practical. They’re receiving just as much emphasis as the other number area, which makes it more interesting...

(WP2 – 12/09/00 – II)
(vi) School culture / structure / colleagues (IC)

Five teachers SP2, SI2, SI3, WC2 and WP1 found that school culture, supportive school structure and supportive colleagues were all factors that gave rise to changes in their practice.

WP1 said that she observed other teachers and incorporated those practices, which she liked. She said: ‘...If I see another teacher using a method that I like, I steal that idea...’ (WP1 – 06/09/00 – IC). WP1 and SI2 were deeply influenced by their school culture and staff recognizing them as valuable change agents. Both talked highly of them.

...Great staff, good reputation, supportive staff, good school in behaviour and attitudes... staff meetings go for an hour... go for a long time and you’re welcome to give ideas and if they like your idea, they will always take it. When I was a casual and when I told something... they are like, ‘Oh, we’ll use that!’ This is great and willing to listen and if they think it’s a good idea, they will vote on it...

(WP1 – 06/09/00 – IC)

The school is very open to new ideas... I have met a lot of teachers and have been able to talk to them and find out what they are doing in different subject areas and when I have talked to the teachers at this school about new information and ideas, they are always ready to listen and think whether or not they want to implement them into their classrooms...

(SI2 – 02/08/00 – IC)

It seemed that WC2’s practice was affected by the school culture.

...We are very lucky here because lots and lots of ideas are put forward and the principal is very, very fair and she tries to provide as much as possible, as far as resources and things like that...

(WC2 – 16/08/00 – IC)

WC2 also valued her colleagues’ help and advice:

...The teachers here are wonderful and everybody’s always willing to help... and some will always be happy to say, “Look, I’ve got something in my classroom that works, you try it” and they are willing to share their ideas...

(WC2 – 16/08/00 – IC)
Furthermore, WC2 talked of a complex process in which supportive colleagues were an effective element in influencing her teaching practice. This process started with the inservicing at the Catholic Education office and imparted through supportive colleagues to each individual teacher. WC2 described this process in detail as,

We usually go to the Catholic Education Office (CEO)... Occasionally, if we have our staff meetings on Monday afternoon, if we are lucky, someone from the CEO will come out and will inservice us here... We were to have a really big inservice at the beginning of the year... Even if not the whole staffs are given the opportunity, perhaps one of the executives will go to one of the meetings and then they will come back and they will share with all the staff exactly what has gone on. If there are any new developments, yes, which is great, so we know exactly what’s going on...

(WC2 – 16/08/00 – IC)

Consistent with all these views, as an administrator, SI3 described how she motivated other teachers towards ‘change’. She conveyed that,

...I try to expose them to people who are good at teaching maths so I encourage them to go to inservices and to courses. I encourage them to visit other schools who have these great mathematics programs in operation and encourage them ‘to have a go’. Change sometimes happens slowly but I try to be flexible and I try to be a facilitator and an encouraging person and I find that’s a good way. It works for me...

(SI3 – 07/06/00 – IC)

(vii) Reflective practice (IR)

When practising teachers were questioned about reflective practice, only five of the twelve interviewees, SI1, SI3, WC1, WC2 and WP3 acknowledged that they kept a diary or a reflective journal while others admitted that they looked back in their ‘head’. However, all interviewees except SI1 declared that they gave opportunities for children to reflect. Further, all interviewees except WC3 were of the opinion that ‘asking primary children to write a reflective journal for learning maths’ was a good idea although only SI2, SI3, WC1 and WC3 carried out it with children.
WC2 described her way of reflective practice as,

I have a daybook and I write out every single thing I do each day. I comment on what worked within the class. I comment on perhaps what could be improved upon and also how the children are going. You know, whether they are enjoying things, whether they are having difficulties in grasping concepts, so that's everyday and at the end of the week, I do an assessment of just how the week has gone within the class. I have that for each day of the term.

(WC2 – 16/08/00 – IR)

Although she kept a diary, SI1 accepted the inadequacy of her reflective practice:

I have a diary in which I write things about the students, about my teaching. I guess the reflection goes both ways – about how my students are learning and how I'm teaching. I think it's got to be a bit of both, but... I don't think I do enough of it and we often fall into the trap of doing too much and reflecting too little.'

(SI1 – 22/08/00 – IR)

Also, SI1 offered the same excuse for not giving her children an opportunity to reflect on their maths learning. This can be evidenced by her comments,

...I think that is a fault. We fall into the trap of doing things all the time and reflecting very little... one of the reasons probably is that there is so much to get through, as far as the curriculum goes, and there is little time for reflection...

(SI1 – 22/08/00 – IR)

WP2 articulated his view on reflection referring back to his experience. He said,

I suppose it's better I keep a daybook but I think I just do it in my head most of the time, just think about things and see other people... that's good because it makes you think about you own processes. In the past I've had a lot of supervision over the years, that sort of things died away these days... it helps you reflect as well... But the older you get, you tend to look more after yourself. You tend to reflect on yourself all the time, as it's better...

(WP2 – 12/09/01 -- IR)

Furthermore, WP3 valued reflective practice with both students and himself. Although he was of the opinion that writing a reflective journal, in learning maths
is not necessary for children, he explained the importance of his method with children:

... When we finish, we have reflection time, good to correct your work in mathematics, see where you went. We sit back and ask how we went and how we are doing. Do you understand the concept that you learn? Some students are frustrated and that's an important reflection because it shows they are having a difficult time. To understand those problems and how we can best remedy the problems they are having. I think reflection time is important...

(WP3 -- 18/10/00 -- IR)

WP3 also contented that self reflective practice could improve one's teaching practice, which appeared in his comments,

...And after years and years of teaching, you are continually reflecting, always looking for different ways of getting the concept across. If it doesn't work one way, you go back and think of another strategy...

(WP3 -- 18/10/00 -- IR)

To sum up, while discussing their beliefs held about mathematics, mathematics teaching and mathematics learning, the twelve practising teachers who were interviewed in this study, also discussed about the influences on forming beliefs into their classroom practice. All these influences seemed to develop beliefs towards teaching and learning.

5.5.4 Teacher perceptions about external factors inhibiting change

Links between beliefs and instructional practices of teachers are well documented as reported in Chapter 2. Although some research papers have described consistencies between beliefs and classroom practices, inconsistencies have also been identified and reported by several others. These inconsistencies were accounted for in terms of constraints that teachers face.
While describing their beliefs about mathematics, mathematics teaching and mathematics learning, the twelve practising teachers, in their interviews, were asked to identify factors that had inhibited their instructional practices. The four major constraints identified were:

1. lack of finance,
2. lack of time,
3. unsupportive classroom culture, and
4. school policy

These beliefs about the factors inhibiting change were most apparent in their responses to the interview questions on 'ideal world' teaching (Q.7 & Q.8 of the semi-structured interview schedule for teachers). The questions that were posed were the following:

1. In an ideal world, how would you like to teach mathematics?
2. What are the things that might prevent this?

The justification for these two questions on ideal world teaching was that the teachers might feel free to express their ideas inherent in their mind, without any hesitation if it were an 'ideal world'. The external factors preventing change, in the teachers' opinions, are discussed under the four categories mentioned above.

(i) Finance (FF)
The major constraint that would prevent change was lack of finance or funding, as perceived by the participants. All twelve participant practising teachers strongly contended that lack of money would be an obstacle to implementing their way of teaching. SP2 expressed this view in simple terms as,

Things that prevent my ideal world teaching of maths... yeah, financial backing. Of course, funding is always very limited...

(SP2 - 06/06/00 - FF)
SP2, SI1, WC1 and WC2 stated that the lack of money would be a constraint as it was necessary to get the resource materials they wanted to have, for example, SI1 perceived the availability of money as important to buy lots of games and concrete materials. According to her, money was a major constraint to her way of teaching as it was not spent on buying resource materials and she insisted that it was due to lack of knowledge:

...Lack of resources and that comes from lack of knowledge of how valuable these things are... I guess unless the school realizes how important games and concrete materials are to teaching, they will go back on using worksheets, because it's just an easy thing to do. Put a worksheet in front of a child. That will keep them quiet for the next half an hour working on it. It is much more difficult to think of creative ways in which to teach them...

(SI1 - 22/08/00 - FF)

WC1 also held a similar belief: ‘...Yeah, funding... money and the ability to assess that funding in a school situation...’ (WC1 - 27/06/00 - FF).

WC2 valued computer programs as important to her teaching and found money a major constraint to access to them.

...Lots and lots of resources – lots of hands-on materials, computers. We have some wonderful maths programs on the computers, but you can see they are only very old ones. The children don’t get a great opportunity, so it would probably be wonderful to have a lot more computers and lots and lots more resources, because there are a lot of resources out there, but not enough money to spend on them. So, that would be wonderful – lots of technology to help the children, because that’s the way we are going...

(WC2 - 16/08/00 - FF)

While admitting money as the major constraint, SP3 identified government policy as the major obstacle in getting money.

...Money – government money... They are spending millions on the Olympic games... and what do we get – nothing and we have to fight for everything we get – even our wages... we have to fight for. So, they are not going to give away money for some ideology that children should learn better.

(SP3 - 20/06/00 - FF)
SI3 was much concerned about the experience that was important to children in her 'ideal world' teaching and accepted that her teaching would be prevented by the lack of money. She said, '... it's just money... yes, all those things cost money...(SI3 – 07/06/00 – FF).

(ii) Time (FT)
Lack of time was considered as another constraint in addition to the lack of money, by seven of the participant teachers interviewed. SP2, SP3, SI1, SI2, SI3, WP1 and WP2 felt that it would be easier to teach if they were given more time. WP1 explained this as,

...Because you are not going to help all the kids that need the help, and it's not enough hours in the day-time in your classroom to help the kids that you'd love to spend an hour with just helping out and talking to. You don't have that time – time is always a factor...

(WP1 – 06/09/00 – FT)

However, SI1 felt that more time was needed during the preparation phase of her lessons. She believed that financial problems could be overcome through the creativity of teachers, but that would not be possible because of time constraints:

...Well, maths games – they are expensive to buy, but some of them are simple to make and the concept behind is just so simple that the school doesn't need to go on spending thousands of dollars on those games. Maths teachers can actually make them or if they have teacher aids, they can instruct them to make them, laminate them and have them for the year after and the year after... but we are not imaginative enough to create them and we haven't the time to create them...

(SI1 – 22/08/00 – FT)

(iii) Classroom culture (FC)
Culture of the classroom was a constraint mentioned by eight of the participant teachers interviewed, as it was not manageable to keep going smoothly with their
teaching. According to these interviewees, classroom culture becomes a constraint, in particular, the size of the class, ability levels of children and behaviour of children.

(a) Class size (FCS)
SP2, SI1, WC3, WP1 and WP2 were of the opinion that to be successful in their teaching, the class size should be manageable and when asked for a number, all of them suggested that it should be less than twenty.
SP2 disclosed her view remembering her past teaching as,

An ideal number would probably be, for example, I taught in a private school in Holland, we had 18 children in a class, and suddenly I found it very manageable. I could assess them very accurately. I could teach them in a far more direct and better way, so, 18 would be an ideal number...

(SP2 - 06/06/00 - FCS)

WC3 put the blame on 'politics' for not having a class of manageable size. He expressed his view with courtesy:

I guess definitely it's the politics. You can't have smaller classes in situation like Wollongong... I guess it's the politics of having to have a certain amount of children in your class...

(WC3 - 21/06/00 - FCS)

(b) Ability levels of children (FCA)
SP3, SI1, SI2 and WP3 expressed that the culture of the classroom would be a constraint to their teaching because of the varying ability levels among the children. WC3 compared his beliefs about 'ideal world' teaching to his current classroom practice indicating the difficulty with children of varying ability levels:

Ideal world will put us into a situation where we have all the aids, all the assistants, all the equipment that you can get. You have a small class load, one-on-one with student where you have a greater success rate as opposed to having a classroom where you have mixed ability groupings, teaching to different levels within your classroom, obviously those aspects would not come into play in the ideal world...

(WP3 - 18/10/00 - FCA)
On the other hand, SP3 was much more concerned about the language ability of children in teaching language related mathematics topics. She cited this example:

...They are usually better at learning maths than anything else. Usually, it's their language related subjects like writing and reading that are more difficult for them. Mathematics, if you just go by operations and facts, they do very well in that area. They have difficulty in space and measurement because there is a lot of language involved in that, like heavy, light, long, short and so forth, so that it's more different for them...

(SP3 – 20/06/00 – FCA)

(iii) Behaviour of children (FCB)

SP2, SI2 and WP1 referred to the behaviour of children in relation to the culture of the classroom as a constraint on their teaching. WP1 grumbled that ‘behaviour of kids these days prevents a lot of good teaching going on... (WP1 – 06/09/00 – FCB). SI2 added to this with the comment, ‘if children are misbehaving, then teachers often don’t want to give them exciting activities because the children could misbehave...’ (SI2 – 02/08/00 – FCB).

SP2 described how this issue had affected her teaching.

...Last year I had an extremely poorly behaved class, and I had to accept that group work with concrete materials was not the best way to teach maths in that room because the behaviour problems were quite bad...

(SP2 – 06/06/00 – FCB)

(iv) School policy (FP)

Although the constraints discussed so far are related to school policy, only SP2, SP3, WC2 and WC3 mentioned school policy as a distinct constraint on their teaching.
SP2 pronounced on the school policy concerning the use of textbooks in her school:

...We feel the pressure to get the textbook completed by the end of the year, so we have to allocate enough time for that...

(SP2 - 06/06/00 - FP)

SP2 further elaborated on this issue by the comment,

Although in my early years of teaching I tried to integrate maths to a fair level, now I don’t, and especially at this school, where it’s stated that we will use textbooks. This is not a teacher decision, from my understanding, and then it is very difficult...

(SP2 - 06/06/00 - FP)

To summarise, all twelve participant teachers in the semi-structured interview identified lack of finance as the major factor that would constrain their teaching. There was also consideration of lack of time, unsupportive classroom culture and school policy. Further, they were aware that these external factors could place constraints on their beliefs if they were put into practice.

5.5.5 Student teachers’ perceptions about the preservice programs (P)

(i) Enthusiasm (PE)

During the interviews, only student teachers were asked about how they perceived the preservice program. Of the 12 student teachers interviewed, all three from the 1st year acknowledged that they were not in a position to comment on the mathematics component, as they had not done the core subject in mathematics so far. However, S11 and S13 declared that they would do mathematics as an elective in future. S12 was strong in her determination not to do mathematics as an elective as she did not like mathematics.

Among the nine others, only S41 had done two electives on mathematics. S42 and S43 stated that they had to give up doing mathematics as an elective
because of the inconvenient time schedule for mathematics electives in their program. All five student teachers from 2\textsuperscript{nd} year and 3\textsuperscript{rd} year except S21 intended to do maths, as an elective in the near future in their preservice program while S21 had not decided.

Enthusiasm to do mathematics as an elective was reflected in various responses. For example, S33 liked maths; S23 and S32 valued the importance of mathematics and wanted to be more confident with the subject; S22 and S31 desired to do maths electives as they felt they were not that much good at mathematics:

I would like to be able to teach maths properly. I think it's a really important subject...
(S23 – 13/04/00 – PE)

Probably just to get more experience. I have chosen science before... So, probably trying to get more experience being more confident at teaching maths in the classroom... just want to be more confident, more able ... something like that...
(S32 – 09/08/00 – PE)

I just want to be a better maths teacher because maths is not one of my strongest points. So, I think its important for me to do a maths elective.
(S22 – 25/08/00 – PE)

I have chosen it because... to just gain ideas of teaching strategies because I believed I wasn't thorough enough, I didn’t have a bigger understanding of how to teach mathematics in the classroom.
(S31 – 03/10/00 – PE)

(ii) Strengths (PS)
All nine student teachers except the three from 2\textsuperscript{nd} to 4th years mentioned the strengths of their preservice program in relation to mathematics. Of them, five student teachers, S21, S23, S33, S42 and S43 mentioned the emphasis on a conceptual knowledge base as a strength while four student teachers, S23, S33, S41, and S43 noted the development of practical activities through their program.
Further, S23 and S32 noted the importance of using concrete materials in primary mathematics teaching while S22 and S31 valued the emphasis on teaching strategies. Only S43 mentioned about the importance given to relating concepts to real life situations.

(iii) Weaknesses (PW)
While commenting on the weaknesses of the preservice program in relation to mathematics, S21, S31 and S43 felt that the subject was too brief and the emphasis given was inadequate while S21 stated that it was also uninteresting. S31 suggested that there should be more than one core subject in mathematics. S22 and S32 were not happy to have the practicum before the core subject was taught. S32 was also bothered by lack of guidance on the use of outside materials other than those mentioned in the syllabus document. S21, S22 and S33 saw the program as uninteresting while S33 felt that this was due to directly reading from a book. S42 delivered that the program did not develop confidence in mathematics teaching. Further, S22 was not quite satisfied with doing everything at University while S23 felt that it was very repetitive.

Only S41 commented on the mathematics electives she did. She chose two electives one of which focused on teaching strategies and the other on issues of mathematics education. However, S41 felt the emphasis on teaching strategies was inadequate and the elective on issues of mathematics education as not ‘that great’.

Student teacher interviewees in this study displayed an enthusiasm to do mathematics as an elective, which reflected their belief in the importance of mathematics. However, this enthusiasm was diminished by perceived weaknesses in the mathematics preservice program.
5.5.6 Perceptions about the NSW curriculum and policy (C)

(i) Syllabus document (CS)

When the twelve student teachers were questioned on what they knew about outcomes, strategies, content and evaluation presented in NSW Department of Education's syllabus documents for primary mathematics, only S41 offered a response. S41’s comments were not detailed she said only that outcomes and content were divided into three strands – space, measurement and number, strategies were contextual and practical, and evaluation was by pen-and-paper test. This shows that she may not be aware of the document *Mathematics K-6 Outcomes and Indicators* (1998) which includes ‘working mathematically’ as a fourth strand.

Practising teachers were asked about the areas they most agreed or disagreed within the NSW Department of School Education's Policy and Syllabus for mathematics. Eleven participants except SI2 acknowledged that the syllabus documents were good while SI2 said that she was not familiar with them. The key words used by individual teachers were:

- wonderful / a very good document / very highly regarded/ one of the best document
- well structured / well set out
- easy reference / easy to locate the information / easy to read user friendly / easy to use / very useful
- good activities
- well written outcomes
- accessible resource
- practical

SI2 included many of these key words in expressing her view about the syllabus document:
The syllabus, I think, is wonderful. I think it is very structured, first of all, easy to read, easy to locate the information that you are after and on the bottom of each page, the suggestions, the ideas, the activities are really good... activities that you don’t have to worry. ‘Oh, am I going to be able to find the resources for it?’, they are readily available, the resources they suggest and they are easily implemented in the room. So, they are the main things I like about the syllabus.

(S12 - 02/08/00 – CS)

While talking about the benefits of the syllabus document, WP2 described how it was set up:

...The syllabus is one of the best documents the Department has produced... one of the best to use. It’d be the most used document in the schools, I’d say, because it’s practical. You can actually go to a page, read what you have to do for the grade or that particular stage, it gives you some activities for it, what’s what, what to assess, what to evaluate. It’s all set out really well...

(WP2-12/09/00-CC)

A similar appreciation was expressed by WP1. She noted about the activities and ideas, and integration of them:

...I like how it’s set up, strands and the set up at the beginning. Numeracy, addition for K, language, this is what you should use, these are the outcomes you should achieve... Everything is very set out and easy to read... Pick and choose what you are going to do, make sure you get space areas, numeracy, measurement... well laid out, easy to read... Read it for ideas and integrate ideas...

(WP1 - 06/09/00 – CS)

When asked to suggest changes to the syllabus, six of the practising teachers were of the opinion that it had to be updated. Of them, SP2 suggested that she would like to see the new outcomes and indicators integrated and the objectives updated while SI2 was of the opinion that it should include more information for the Kindergarten strand. Further, SI1 wanted to use more ideas for resources in terms of games and practical materials while WP3 stated that the methods of teaching should be updated. Although they said that the syllabus document should be updated, WC1 and WC2 did not mention anything specifically.
Suggestions from the student teachers when asked for a new policy also dealt with the syllabus. Only four student teachers responded. S11 suggested that hands-on learning must be stressed while S21 proposed more emphasis on real life content and contexts with problem solving. S32 emphasised that learning should be thorough fun activities with positive environment created while S42 suggested that the new policy should encompass child-centredness and hands-on, meaningful, group activities for enjoyment. While all these suggestions were aspects that were already there in the syllabus document, these suggestions from student teachers for a policy show beliefs in a contemporary, constructivist view of teaching and learning of mathematics.

(ii) Integration (Cl)

When student teachers and practising teachers were asked about their view on integrating maths into other areas of the primary curriculum, all twelve student teachers said that it was a good idea while only eight of the practising teachers accepted it. (SP1, SI2, SI3, and WP3 did not respond to this question).

SP2 described the benefits of integration in her comments:

I've spoken to people who do that, and the children then become engrossed and immersed in this theme and everything links and everything makes sense to them.

(SP2 - 06/06/00 - CI)

She also indicated the difficulty in doing integration against the policy of the school on textbook work.

...But the difficulty lies with the fact that with the syllabus you’d have, you’d have to keep track of what you are doing, rather than just looking at the scoping sequence for your school and ticking it off as you go, you’d have more bits and pieces that you would be touching on and recovering and coming back to. I think that would be the difficulty – keeping track of what you’ve covered and what you need to cover. It would be less straightforward than, say, working through a maths textbook, where it’s all just laid out in front of you.

(SP2-06/06/00-CI)
WC2, being a strong advocate for integration, cited an example:

Oh, I think it's very important and I think there's lots that can be done within that. We went outside, a little while ago and we had a sports lesson in a sandpit outside, with long jumps, and we turned it into a measurement. We took our containers and we measured and emptied half-filled, and did all sorts of things, which was great.

(WC2 - 16/08/00 – CI)

WC2 also described the limitations of integration:

...But there are lots of things that you can do and we tried to integrate as many KLAs as possible into as many different ideas. I mean it's not always possible with maths, but there are some instances where you can and the kids seem to benefit too, because it's not just mathematics this time or English this time, it could be all integrated.

(WC1 – 27/06/00 – CI)

WC1 also talked about the limitations imposed by the inadequate language abilities of children with reference to problem solving:

I believe that you can integrate maths in many areas, anyway... A lot of problem solving – you have to be able to do well in English to do problem solving, anyway... Children can't do maths unless they can read and write, especially problem solving. If you ask children a problem and if they don't have a good grasp of English or comprehensive skills, they won't know what the problem is asking of them.

(WC1-27/06/00 – CI)

On the other hand, SI2 indicated how it could be interesting to children:

...I think it's very important that integration occurs, because it also provokes greater interest in other KLAs and it doesn't mean that maths is such a dry subject. It can be incorporated into, you know, greater themes of what children were studying, so they reflect greater enjoyment in doing those things than sitting on the table everyday at 11 o clock copying 10 sums from the board...

(S12 – 14/06/00 – CI)
S43 was positive about integration and she was of the opinion that it was a way of overcoming the time restrictions imposed on teachers. However, she claimed that the integration should not sabotage mathematical concepts considered:

I think it's great if it can be done without losing integrity for the maths subjects. If it's done in a way that it's going to undermine the concepts that's being taught, then it shouldn't be done... only to be done if it's not going to detract from the mathematics taught... So, yeah, I think with any Key Learning Area it is great to integrate... because of the time restrictions placed on teachers, it's something that need to be done.

(S43 – 11/08/00 – CI)

Many student teachers and practising teachers showed a strong, well informed belief in the value of integration in mathematics teaching.

(iii) Calculators (CC)

As noted in Chapter 3, only student teachers were asked about the policy on the use of calculators in primary classes. Nine of them made comments on it. (S11, S22 and S31 did not respond to this question.) S12, S13, and S33 suggested that calculators should not be used in primary, as primary maths did not require difficult calculations. Instead, S21, S23, S32, S41, and S42 stressed that the calculator should be used only after they had mastered the basic concepts and basic operational skills.

Further, S42 and S43 were of the opinion that calculators should not be used just to find answers mechanically without understanding while S21 stated that it could be used for safety check and could be used as a good tool for those who could not do mentals. S23 commented that the children become lazy using a calculator and it was bad to have them used all the time. However, S41 claimed that one could save time using calculators with big numbers.

S43 was very much in favour of the use of calculator. She contended strongly that its use was essential.
I think it’s essential in the sense that children need to know how to use calculators properly and effectively... not just to find answers to the questions so that they’re not thinking themselves, I think it’s important to use calculators where children are still encouraged to think and act mathematically.

(S43 – 11/08/00 – CC)

(iv) Problem solving (CP)

When student teachers and practising teachers were asked whether they would emphasise process or product when using problem solving as a teaching strategy in mathematics, all three student teachers from 1st Year said that they would emphasise both. The other nine student teachers claimed that the emphasis should be more on process.

On the other hand, eleven of the practising teachers excluding SI2 acknowledged that they used problem solving in their teaching of mathematics but to varying degrees. Eight of them excluding WC3, WP1 and WP2 made explicit that their emphasis was on process. WP2 valued both process and product as equally important.

While talking about problem solving, SI3 elaborated on the process of problem solving.

...By setting up a situation where they have to discover, they have to solve a problem, so the teacher might pose a problem. A discussion might follow. Various brain-storming activities might take place where they suggest ideas, and then they get an opportunity to experiment with those and see whether their ideas are going to work or not... If we can pull our ideas together and come to a conclusion and say, ‘well, as a result of what we have done, therefore we have seen that this process works best. Is there a rule that we can apply there? Is there some learning that we can put into practice?’

(SI3 – 07/06/00 – CP)
Further, S33 explained why process is more important than product:

...A lot of time, the product is wrong because the process is wrong. So, if the child understands the process, then more likely to get product right...

(S33-04/10/00 – CP)

However, SP2, WP1, and WP2 commented that they would be running out of time when using problem solving. Further, WP2 explained how time, as a constraint, could inhibit change:

...Process... does take a lot of time. You're wasting a lot of time in class to do it. Then often you'll jump back to the simple old drill because it's a bit quicker...

(WP2 – 12/09/00 – CP)

(v) Parent as teacher aid (CA)

When practising teachers were asked about involving parents in classroom teaching, eight of them excluding SP1, SI3, WC1 and WC3, agreed that it was a good idea. However, they warned that it should be the right parents with the right children. WC3 claimed that parents might confuse children with teaching methods, while WP2 said that they could be a pain sometimes. SI1 insisted on the importance of training parents before using them as teacher aids:

I have actually done a course with parents in literacy for them to be able to help the students in the school... But, I haven't found so much in the area of mathematics courses that would be helpful to parents... courses that are available to teach parents in terms of how to help their children at school, but I think it's a great idea.

(SI1 – 22/08/00 – CA)

SP2 and WC2 were of the view that parents could provide wonderful support in group activities.

(vi) Basic Skills Test

Only practising teachers were questioned about their view on the State-wide Basic Skills Test. Nine of them not SP1, SI1 and WP3, commented on it. SP2,
SP3 and WP1 criticised it as only a one shot test while SP2 said that it was not relevant to disadvantaged schools. Further, WC2 claimed that it was not a true indicator always while SI2 and WC1 disliked the media's involvement in the Basic Skills Test and comparing schools in terms of the marks obtained in this test. SI2 articulated about her view on the Basic Skills Test as:

I've thought of many different things about the Basic Skills Test. I think it is a good idea where the teachers are able to see where they're at, what they know, and what they don't know, but I think it is very wrong when schools and media gets involved and says the children from the North Shore got this result and the Out West children got this result. Why is that? I think that is very wrong because it should be a test that is just for that particular child to see what they know, rather than comparing schools.

(SI2 -- 02/08/00 – CB)

SP3 was of the opinion that the Basic Skills Test was not the only way to gauge children. However, SI2 and WC3 mentioned that teachers could see where they were.

To sum up, practising teachers and student teachers interviewed in this study provided their perceptions about the NSW curriculum and policy by responding to some particular issues. Although the student teachers did not know much about the policy, their beliefs were more towards the contemporary, constructivist view of teaching and learning of mathematics.

5.6 Summary of Main Findings

All twelve practising teachers and all twelve student teachers interviewed perceived the nature of mathematics as functional and believed strongly in activity-based teaching and learning. In addition to the functional nature of mathematics, three practising teachers and one student teacher among the interviewees saw mathematics as a means to understand the real world while two practising teachers and three student teachers advocated the problem solving nature of mathematics. Although all 24 interviewees were strong advocates of activity-based learning, 3 practising teachers and 3 student
teachers saw some value in the use of drill and practice while one practising teacher and student teacher valued problem-based learning.

In discussing the influences on forming beliefs into their classroom practice, all 12 practising teachers interviewed made explicit that they had developed their beliefs on teaching of mathematics through their own experience as mathematics teachers. In addition, their own schooling, family background, preservice, inservice, school culture/structure/colleagues and the reflective practice were the other influences, not to all, but each to different sets of practising teachers among the 12 teacher interviewees.

Lack of finance was the major external factor identified by all 12 practising teachers interviewed that had inhibited their instructional practices while lack of time, unsupportive classroom culture and school policy were also identified by different sets of teacher interviewees as the other external constraints to put their beliefs into practice in the classroom.

Student teacher interviewees reflected their beliefs in the importance of mathematics through displaying their enthusiasm to do mathematics as an elective in their preservice program. Conceptual knowledge base, practical activities, use of concrete materials and emphasis on teaching strategies were identified as the strengths in their mathematics preservice program. However, the enthusiasm to do mathematics as an elective seemed to diminish by perceived weaknesses in the mathematics preservice program.

Suggestions from student teacher interviewees for a new policy showed their beliefs in a contemporary, constructivist view of teaching and learning of mathematics. Many of them showed a strong, well informed belief in the value of integration in mathematics teaching. Although their beliefs were more towards the contemporary, constructivist view of teaching and learning of mathematics, they did not know much about the NSW policy on mathematics education.
6.1 Introduction

This chapter presents a discussion of the findings from the analyses of the questionnaire data and interview data as described in Chapter 4 and Chapter 5 respectively. These findings are then used to attempt to answer the related specific research questions, with reference to the literature reviewed in Chapter 2, and to make some recommendations.

This study aimed to explore the perceptions of teacher trainees and practising teachers; and to illuminate the rationale for the existence of any differences between beliefs and practices regarding the teaching and learning of primary mathematics. While the study was based in New South Wales Australia, and is intended to provide data of significance to student teachers and practising teachers in NSW, the implications for the study are expected also to be of significance in the researcher’s home country of Sri Lanka, where changes in policy and practice in mathematics education are urgently needed (and see Chapter 1).

In view of these aims, the research questions described in Chapter 1 are now reviewed in the light of the study findings. They were:
1. What are the beliefs of student teachers and teachers about the nature of mathematics and the teaching and learning of mathematics, and their own classroom practices?

2. How are these beliefs expressed at various stages of the preservice teacher education course and in teaching?

3. What are beliefs about the influences and constraints on classroom practice among the practising teachers?

In deriving these findings, a number of themes have been highlighted in relation to the research questions. These themes include:

- Beliefs about the nature of mathematics;
- Beliefs about mathematics teaching and mathematics learning;
- Teacher perceptions of influences on beliefs about classroom practice;
- Teacher perceptions about external factors inhibiting change;
- Student teacher perceptions about the preservice program; and
- Perceptions about the NSW curriculum and policy.

### 6.2 Background Of Participants

The study involved a two level strategy of questionnaire and semi-structured interview. The questionnaires (Teacher Questionnaires & Student Teachers Questionnaire) were administered to 361 students teachers and 34 practising teachers. The student teachers were from all four year levels of the B.Ed program at Wollongong University and the teachers were from two schools in the Sydney metropolitan area and two in the Illawarra. Further, 12 student teachers and 12 practising teachers derived from the initial cohorts were interviewed with a semi-structured interview schedule.
The study sample varied in age across a large range. Mean ages reflected the tendency of Illawarra teachers to remain in their positions until retirement and the mobile nature of the Sydney teaching population. A similar distribution was observed with the experience of practising teachers—the mean experience of teachers from the Sydney area was only half that of the teachers from the Illawarra area. The length of experience can be significant in how teachers reflect their beliefs (NCTM, 1991; Schram et al. cited in Pejouhy, 1990), although there were some surprising results in this study, as with the Schram study.

Among the teacher interviewees, three had 2-3 years of teaching experience and three had 6-9 years of experience while the other six had 18-30 years of experience. They also held different positions such as casual class teachers, full-time class teachers and senior administrators. The initial sample of 34 practising teachers represented every primary class. This reference to teaching experience is made here as systematic differences in beliefs of the practising teachers by teaching experience were observed. These differences are discussed below.

6.3 Beliefs about mathematics, mathematics teaching and mathematics learning

Beliefs about the nature of mathematics and about the teaching and learning of mathematics were identified through the responses received from the survey questions as well as from the interviews.

The responses to the survey questions about the nature of mathematics indicated that both student teachers and practising teachers in this study, in general, agreed that mathematics should be seen as (a) a powerful tool for solving problems, (b) a practical way of coping with everyday life, (c) a stepping stone to higher education, (d) a precise discipline for training the mind and (e) a
creative activity. This general agreement was evident from the mean values obtained for the responses on the Likert-type scale. Both practising teachers and student teachers took a broad view of the nature of mathematics – the views of individuals were not limited to a unique perspective. This is important in relation to their beliefs about the purpose and nature of mathematics teaching in primary schools. From this overall perspective, the teachers' epistemology is far closer to the constructivist than the behaviourist paradigms (Holt-Raynolds, 2000; Kochler and Grouws, 1992; Noddings, 1990).

Similar beliefs were also reflected in the interview data. When questioned about why mathematics should be taught, both practising teachers and student teachers disclosed their beliefs, referring to the nature of mathematics, that mathematics is (1) functional, (2) a means to understand the real world and (3) a powerful tool for solving problems.

What was clearly reflected in both questionnaire data and interview data was the belief in the functional nature of mathematics. All interviewees – both practising teachers and student teachers – believed that mathematics should be taught because it was important in everyday life. As Duffy and Cunningham (1996) noted, there is a growing body of evidence that demonstrates how students make meaning through the materials of an individual's everyday experience.

It is to be expected that the functional nature of mathematics receives a very positive response from the respondents and that it is seen as an inseparable part of daily experience. Also, it is the responsibility of teachers to make learning mathematics enjoyable for children. To make it enjoyable, teachers have to think of appropriate teaching/learning strategies. Thus, they have to value the functional nature of mathematics showing the importance in everyday life by relating their teaching to real life experiences (Duffy & Cunningham 1996; Tate, 1994). It is interesting to note, however, that some of the student teachers disagreed with the questionnaire belief statement that “mathematics should be
seen as a practical way of coping with everyday life". This may have been due to negative experiences they had in their own schooling or may be they were novices who could not see the real life relevance in mathematics as important. Mathematics education needs to be embedded in the natural or cultural context of the students (Blumenfeld et al., 1994; Melone and Ireland, 1996; Tate, 1994; Yackel, 1990).

Although the most strongly supported belief statement in the questionnaire was that ‘mathematics should be seen as a powerful tool for solving problems’, this was not directly reflected in the interviews. Only two practising teachers and three student teachers mentioned their belief in the importance of the problem nature of mathematics. These two practising teachers were from the Sydney independent school and one of them, who also held a senior administrative position, was a strong advocate of a problem solving approach in teaching mathematics. She described a problem solving approach when asked to describe a typical lesson, as mentioned in Chapter 4. This is an important aspect of an effective change process where those empowered to make changes are most likely to engage in implementing strategic shifts in policy (Fullan, 1999; Gaskey, 1994; NCTM, 1995).

The three beliefs about the nature of mathematics that emerged in the interview data – mathematics is functional, mathematics is a powerful tool for solving problems, and mathematics is a means to understand the real world – are also stated in the primary curriculum of NSW. Mathematics K-6 (New South Wales, 1989), the NSW syllabus document for primary curriculum, clearly delineates these three beliefs about the nature of mathematics in statement of principles as,

...most particularly it [mathematics] is a search for patterns and relationships... which can be applied, in finding solutions to problems, improving our understanding of the world around us and meeting the specific needs of people... (p.2)
As the 'specific needs' of people relate to the functional nature of mathematics in everyday life, 'finding solutions to problems' and 'improving our understanding of the world' can also be considered as part of everyday life and be related to the overriding belief of the functional nature of mathematics. However, it was not clear from their responses about the nature of mathematics whether the participants in the study perceived it in this way. But they later showed they were aware of the documents in another question. It is the obligation of professionals to do what is best for the client (the student). The knowledge of, and the ability to, interpret policy documents are indicators of professionalism (Darling-Hammond & Wise, 1992).

Further, the belief about the nature of mathematics that mathematics should be seen as a creative activity was not mentioned explicitly in the interviews by anyone. The nature of the interview was such that participants were not prompted, but asked open ended questions about their immediate beliefs to find out whether they employ strategies that emphasise creativity.

While many teachers and student teachers agreed on the questionnaire with the statement that mathematics is a creative activity, those who were interviewed were more likely to express a belief in the functional nature of mathematics. It seems that in practice, teachers see mathematics and mathematics teaching primarily in terms of its functional nature rather than its creative nature. This is reflected in their beliefs about the purpose and nature of mathematics teaching in the primary school.

Mathematics as a 'creative activity' is emphasized in primary curriculum and in current constructivist theories (Strommen, 1996). The NSW syllabus document (NSW Department of Education, 1989) states that 'mathematics can be a creative activity involving intuition and invention' (p.25) and recommends that 'students should be given opportunities to explore mathematical materials, concepts and ideas that freely assist them to develop their intuitive ideas about...
mathematics' (p.25). Further, problem solving is valued as 'an exciting and creative process for students and teachers' (p.25).

This view is also reflected in much of the literature. For example, while identifying three contrasting conceptions of the nature of mathematics, Ernest (1989) recognised a dynamic, problem driven view of mathematics as an everlasting field of human creation and invention. Teacher interview responses in this study revealed that some teachers valued what could be seen as creative nature of mathematics by using concrete materials in their teaching. However, student teachers from 1st Year in this study did not seem to be as aware of the problem-driven nature of mathematics (Warren & Nisbet, 2000). This was evident when they were asked whether they would emphasise product or process while using problem solving as a teaching strategy. All three 1st Year student teachers stated that they would emphasise both process and product while others’ emphasis was on 'process'.

This conception about problem solving seems to indicate that the 1st Year student teachers were not aware of the constructivist theory on problem solving. This may also be linked to the occurrence of a significant difference between student teachers and practising teachers with the belief on the creative nature of mathematics.

Responses from the questionnaires, in general, revealed that both practising teachers and student teachers in this study had similar levels of preference for different teaching strategies in mathematics (Parmer & Cawley, 1997). This similarity was observed from the mean values for each strategy for the responses of practising teachers on a 5-point Likert-type scale.

In general, both groups of participants believed in large measure in the frequent use of hands-on experiences, problem solving, and co-operative learning as teaching strategies. A reasonable number of respondents preferred resource
based learning, guided discovery, and drill and practice. Here we see that 'Habit Formation' remains an important part of pedagogical practice (Battista, 1994; Leder & Forgasz, 1992). Nevertheless hands-on experience was seen to be necessary (Leder & Forgasz, 1992).

The last frequently preferred strategy was 'journal writing'. Only a few respondents from both student teachers and practising teachers showed a preference in the questionnaire to 'often' use 'journal writing' as a teaching strategy. This was also reflected in teacher interviews. Teachers said that they did not have time for this. However, 'journal writing' is considered to be a kind of reflective practice, and if this disinterest is seen persistently in teachers, it may have implications for classroom practice as reflective practice is considered a main element in teacher change. Writing in all forms is an effective form of discourse for learning mathematics (Anderson, 1996; Miller, 1993; Wilde, 1991).

Although student teachers displayed stronger preferences than practising teachers for 'guided discovery' (chi square = 9.61, p = 0.008) and 'problem solving' (chi square = 8.54, p = 0.014), this was not reflected in the interview data. None of the student teachers mentioned problem solving or problem-based teaching/learning when questioned about how mathematics should be taught, while only two practising teachers mentioned it. Further, activity-based discovery teaching/learning was mentioned by seven practising teachers and only by two student teachers.

Discrepancy between beliefs depicted by questionnaire data and interview data can be explained in that what people say in a questionnaire is often what they think is "correct" and what people say in an interview often reflects what they actually think and "do" and therefore relates to the real classroom rather than the "ideal" classroom (Hakim, 1987; Owens, 1995; Robson, 1993). Interview data reveals beliefs that are most important to them as teachers. In this way, the
interviews present a picture that is more likely to reflect what teachers really think and believe and what it is really like in classrooms.

Student teacher beliefs are often described as naïve and uninformed where 'naïve beliefs represent little or no evidence of theoretical knowledge base and/or represent a lack of relational understanding of concepts' (Brownlee et al., 1998, p.108). The student teacher interviewees in this study seem to hold naïve and uninformed beliefs of a superficial nature, which can be evidenced from the sometimes not very reflective interview data that were recorded on some occasions.

The interview data revealed that the participant practising teachers and student teachers in the study saw importance in a variety of different teaching/learning strategies. All 24 interviewees contended that children best learnt through activities and valued hands-on experiences to cater for these needs. Although all were strong advocates for activity-based learning, they noted this preference with focus on various aspects such as discovery, fun and enjoyment, real life relevance, group work, visualisation, understanding and textbook work. Most of them made explicit the use of concrete materials in association with these different teaching/learning strategies.

Among the participants interviewed, only two practising teachers explicitly discussed 'problem-based learning' and its teaching as important and these two teachers had extensive teaching experience. 'Drill and practice' was also mentioned as a teaching/learning strategy by three student teachers and three practising teachers, of whom one was the same practising teacher who discussed 'problem-based learning' as important. Again, the three practising teachers had 18-30 years of teaching experience. Similar and surprising differences in viewpoint emerged in relation to the length of experience of the teacher, which will be discussed further.
The analysis of questionnaire data and interview data also showed that the participant practising teachers in this study were consistent in their beliefs about the importance of different strategies in mathematics teaching and learning, throughout the study.

Many of the proponents of different models to categorise the beliefs about the teaching and learning of mathematics see ‘hands-on learning’ as a contemporary constructivist approach to learning (Anderson, 1996; Burton, 1993; Perry, Howard & Tracey, 1999; Warren & Nisbet, 2000). The intention to use hands-on experiences, problem solving, co-operative learning, resource-based learning, and guided discovery implies a contemporary constructivist perspective, as these teaching strategies are elements of a constructivist approach to teaching mathematics. This analysis shows that the participants in this study seem to hold beliefs of a contemporary constructivist nature about the teaching and learning of mathematics.

However, the belief in the use of drill and practice in teaching received a mean value, which indicated that the practising teachers and student teachers were, in general, in favour of this strategy. This intention to use drill and practice as depicted in questionnaire data and interviews show that they still hold a traditional perspective. Nevertheless, the advocates among the interviewees for drill and practice admitted that such practices were to a certain extent only and in some particular instances. This is what was stated in the NSW syllabus documents too as stated, ‘the development of understanding should, as a general principle, precede a requirement for both automatic recall of factual information and speed and accuracy in performing mathematical computations’ and ‘skills should be maintained through meaningful practice and enjoyable drill’ (NSW Department of Education, 1989, p.5). Understanding plays little or no part in habit formation learning theories, yet meaningful practice does contribute to skills development (Battista, 1994; NCTM, 1989; Skemp, 1989).
The principle of using hands-on activities in teaching mathematics is supported by the enjoyment children get through these activities. It is the nature of mathematics learning that it is ‘more effective when it is interesting, enjoyable and challenging’ (NSW Department of Education, 1989, p.4) and then it is important that teachers ‘respond to emergent opportunities to capitalize on the students’ interests and needs with the appropriate use of a variety of materials’ (p.4) to ‘discover and create patterns’ (p.5).

This view was reflected in the way a practising teacher from the Sydney public school in the sample used textbook in mathematics. She stated that she used textbook supplementing it with hands-on activities to make the learning enjoyable.

Most of the current documents such as *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 1989), *Everybody Counts* (National Research Council, 1989) and *A National Statement on Mathematics for Australian Schools* (Australian Education Council, 1991) emphasise the use of different teaching/learning strategies by giving particular reference to understanding and the usefulness of mathematics in different situations. These applications of different strategies help to develop problem solving abilities in children (Ernest, 1989).

Problem solving strategies are numerous. In order to become problem solvers, children need to explore, discover, describe and record relationships (Anderson, 1996; Hiebert et al., 1996). They need to frequently engage in such activities in small groups which ‘will relate to situations which are relevant to their daily experience’ and where they can ‘share ideas, manipulate materials, and practice fundamental skills and routines’ (NSW Department of School Education, 1987, p.12).
Accordingly, the beliefs about activity-based learning with focus on discovery, fun and enjoyment, real life relevance, group work, visualization and understanding show that practising teachers and student teachers are in line with the new reforms and initiatives proposed by the NSW Department of School Education.

Further, the beliefs held by student teachers and practising teachers on the nature of mathematics are related to beliefs about the teaching and learning of mathematics. Like the Warren and Nisbet 2000 study, the student teachers had a more limited view of the nature of mathematics than did the practising teachers (see Chapter 5). Eventually, these beliefs can be expected to be reflected in their classroom practice. The belief on the functional nature of mathematics is related to teachers choosing real life activities as teaching/learning strategies. All of the respondents in this study believed in the functional nature of mathematics and held beliefs about the teaching and learning of mathematics, which focused on activity-based learning. This was related to a belief in the use of concrete materials and activities relevant to real life situations. The real life relevance motivates children to learn mathematics with fun and enjoyment. According to constructivist theory on mathematics, children best learn when involved in constructing their own knowledge by interacting with their social and physical environment and making meaning out of them rather than passively receiving it (Merril, 1992).

However, some of the respondents believed in problem solving and to some extent in drill and practice. Although all respondents did not mention these two strategies, the teachers who advocated these two strategies seemed to reflect the beliefs consistently in several occasions.

The beliefs that practising teachers and student teachers held about the nature of mathematics and about the teaching and learning of mathematics were also recommended in NSW curriculum and syllabus documents. However, it is important to see whether these beliefs were in actual practice as there are often
mismatches between beliefs and practices (Sozniak, Ethington & Varelas, 1991; Thompson, 1992). Because of the limitations in this study, it was intended to delineate the beliefs on classroom practice and on factors enabling/inhibiting change. This will be discussed below.

6.4 Influences and constraints on classroom practice

As cited above, mismatches between beliefs and classroom practices have been reported. However, teacher change is fundamental to the implementation of any initiative or policy. As teachers may hold naïve beliefs and uninformed beliefs, teacher education program should draw attention to their naïve beliefs and should facilitate the development of better-informed beliefs. Thus, it is important to investigate beliefs on the influences and constraints on classroom practice.

There were indications in the interviews on how those beliefs on classroom practice held by teachers were inhibited by constraints, when two questions on ‘ideal world’ teaching were raised as discussed in Chapter 5.

It was observed from the interview data that the practising teachers in this study held that their own experience as a teacher, inservice, own schooling experience, preservice program, family background, school culture and reflective practice were all influences on their practice.

However, when grouped into two sets of teachers by their experience, teachers with experience of 18-30 years, the senior group, felt that inservice and the success in their teaching through experience were two of the six most important influences on their teaching practice. Of the six senior teachers, three of them made explicit that the main influence was inservice while the other three mentioned that it was success in their own teaching. However, it was evident from the questionnaire data that all six senior teachers attended a good number of inservice sessions or staff development days during their career. This
indicates that the methods or strategies they applied would have originated in these inservice sessions or staff development days for all six teachers (Allen et al., 1988; Fullan, 1991). Professional development is a systematic attempt to advance knowledge, skills and understanding that changes the way teachers teach (Fenstermacher & Berliner, 1983 in Dunlop, 1990).

On the other hand, teachers with 2-9 years of experience felt that their own schooling experience, inservice and school culture were the main influences on their teaching practice. In terms of school culture, teachers mentioned lack of resources, size of class, children's behaviour and ability levels as constraints on their pedagogical practice. Two of them believed that they developed their current practice through the negative experience they had during their schooling where mathematics was taught in a boring way. They arrived strongly at their belief that they should make mathematics teaching interesting to children. However, schooling experience was positively influential in one of the others as she had a good mathematics teacher during her schooling who used quite a bit of concrete materials and made mathematics enjoyable.

The school culture with supportive colleagues and supportive administration was also influential in two of the junior teachers (with experience of 2-9 years). Two other teachers disclosed that the influential factor was inservice.

However, of the 12 practising teachers, only one with 9 years of experience referred to her mother's strong influence on her teaching. She claimed that the advice and resource materials she received from her mother were very much useful to integrate into her beliefs. She also valued preservice, inservice and supportive colleagues as influential factors in modeling her teaching.

The interview data revealed an important discrepancy between the beliefs of the two groups of practising teachers on the influence on their classroom practice. Senior teachers valued inservice as the most influential factor while it was their
own schooling or the children’s preferences that influenced junior teachers. This might simply be because senior teachers had more experience and more inservice.

Preservice as an influential factor was mentioned only by one senior teacher and one junior teacher. This indicates that they did not recognise much long-term gain from their preservice program. It is also notable that the student teachers interviewed revealed that they did not feel that they were well prepared by the preservice program. Most of them felt that they emphasized on mathematics was inadequate. However, they felt the emphasis on the conceptual knowledge base and practical activities with concrete materials were strong points of the preservice program. Further, an enthusiasm to take a mathematics elective was also shown during the interviews. However, only one of the fourth year student teachers interviewed did a mathematics elective in the preservice program (See Chapter 5 and see Recommendations in this chapter).

The discrepancy between the senior teachers and junior teachers on their beliefs about the influences on practice can also be used to explain the richness in senior teachers’ beliefs about mathematics, mathematics teaching and learning. An inservice might have given insight into their beliefs. With less emphasis on mathematics in the preservice program student teachers may not have had the insight into mathematics, which might have implications for their future teaching. One of the weaknesses of the preservice program, as mentioned by the student teachers was that they had their first practicum before they did their core subject. While describing how to develop professional growth among preservice and beginning teachers, Kagan (1992) concluded that preservice teachers’ beliefs could be changed using extensive field experiences and linkages between theory and practice. Inservice and preservice are two elements that could be used to bring change in teachers’ beliefs.
Another reason for richness in beliefs of the senior teachers can be speculated as due to the fact that the reform initiatives were in the late 1980s and the senior teachers might have actively participated in staff development programs at that time.

It is also quite reasonable to suppose that the senior teachers in this study could have had the intention to be good models among their younger counterparts. This was evidenced in many instances when they talked about their enthusiasm towards new changes in the curriculum.

Another reason may be that some of the senior teachers also held senior administrative positions and they had to implement and practise the new policy initiatives.

Further, it was also noted that none of the participants mentioned ‘reflective practice’ explicitly as one of the influences in their classroom practice. Only when asked about their reflective practice did they respond, although they all acknowledged that reflective practice was important and five of them said that they kept a diary or a reflective journal.

Eleven practising teachers interviewed gave children an opportunity to reflect in some kind of form, either by asking them to write what they had done, or sitting back and sharing their findings with others, or recalling the important facts and to think where they went wrong or where they were not clear.

Although all teachers valued reflective practice as important in teaching, it was not clear from the interview data whether they all meant reflective practice in the same sense as it is described contemporarily. This was evidenced when some teachers mentioned their way of reflecting with children was as asking some quick questions and to find how many of them were progressing. However, reflection is not merely recollection or rationalisation. Reflective practice helps
teachers rethink problematic situations in their teaching/learning. Reflective thinking was recommended as an essential component of any preservice teacher education program by the well-known philosopher and experiential education theorist John Dewey (1904/1965; cited in Mewborn, 1999). Dewey further felt that a teacher who lacks in reflective thinking might become intellectually dependent on those who directly instruct how to teach (Dewey, 1904/1965; cited in Mewborn, 1999). The interview data shows that the participants in this study did not give children enough time to reflect.

Practising teachers related that there are some constraints which inhibit actual classroom implementation of teachers' beliefs as to how mathematics should be taught. Participant teachers in this study identified four constraints—lack of finance, lack of time, unsupportive classroom culture and school policy in their classroom practice. The most widely perceived constraint was the lack of finance. All twelve teachers claimed that it was a major constraint in implementing their actual classroom practice. Teachers were of the opinion that they would like to have more resources, especially computers and CD ROM packages, if they were enough money allocations in their school budget.

Time was another key constraint that was reported by seven of them. There is evidence from research that the more time a child spends in successful practice, the more effective the learning would be (Benett, 1987). Lack of adequate time was reported as a challenge to implement activity-based learning with materials. Teachers felt this inadequacy of time with their lesson planning as well.

Another key constraint that was reported by eight of the interviewed practising teachers was unsupportive classroom culture. Of these eight teachers, five were of the opinion that the class size should be manageable and four of the eight reported that the unsupportive culture would be due to varying ability levels among the children, while three of the eight stated that was due to the behaviour of children.
However, difficulties arising from all these factors such as lack of finance, resources and time, class size and unsupportive culture may be overcome, in part, by organising teaching/learning activities more productively. As mentioned in Mathematics K – 6 (NSW Department of Education, 1989), ‘activity-based classrooms are busy places, characterized by talking and action, and they require teachers to use sound management techniques’ (p.305). Using innovative resources, working in groups, solving problems which relate to children's real life experiences, and the efforts taken to make the learning fun and enjoyment for children may help teachers develop expertise in managing their classrooms and overcome shortcomings from the above constraints.

6.5 Recommendations for further research

Teacher beliefs about teaching and learning are said to affect the form and type of instruction they deliver, as mentioned in the Literature Review chapter. However, student teachers are likely to have acquired naïve beliefs about mathematics teaching and learning before entering into preservice teacher education program. It is the main aim of teacher education programs to integrate these naïve beliefs with theoretically informed beliefs in order to make them function effectively in classrooms (Brownlee et al., 1998).

Today, it is felt that twentieth-century teaching is not adequate to serve 21st century students. States and localities are establishing priorities for what teachers are expected to provide, defining explicit standards about what students should know and be able to do as a result of their education.

The Professional Teaching Standards for the Teaching of Mathematics (NCTM, 1991) specifies experiencing good mathematics teaching, knowing mathematics and school mathematics, knowing students as learners of mathematics and
knowing mathematical pedagogy as important to a professional teacher of mathematics. Accordingly, teacher knowledge constrains what content or subject will be covered and how that will be taught. These two were distinguished well in Shulman’s (1986, 1987) classic typology of teacher knowledge. As discussed in Chapter 2, Shulman (1987) listed different forms of knowledge needed for effective teaching:

Content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical reasoning, knowledge about learners, knowledge about educational contexts, and knowledge about educational purposes and values. The informed application of this knowledge base leads to effective teaching practice (p.8).

Shulman’s notion of teacher knowledge was further developed and discussed in many forums and the role of a mathematics teacher is emphasized as important in helping students ‘to develop effective knowledge structures, representations of mathematical content that will allow the students to productively explore a suitable range of mathematical problems’ (Chinnappan & Lawson, 1999, p.167).

Although the student teacher interviewees in this study felt the emphasis on the conceptual knowledge base and practical activities in their preservice program, their general opinion was that it was inadequate, in relation to the component depicted by the Professional Teaching Standards (NCTM, 1991). However, it may not be possible to give more emphasis to mathematics, as the primary curriculum is composed of six Key Learning Areas.

Although it would be ambitious to expect to do more in one core subject and to change beliefs held for many years in the space of one semester, it is important to look into the initial attitude that the prospective teachers develop towards mathematics during their preservice program.

As the purpose of staff development today is to bring about change in beliefs, attitudes and classroom practices of teachers and ultimately to bring about
changes in student learning outcomes, it may be expected to enrich preservice mathematics education program in order to enhance the chances of bringing about change. Although time is a main constraint in upgrading the content of the preservice program, the knowledge base included in the core subject is limited. Necessary steps may be taken to remedy this situation by shifting some of the subject content on teaching strategies and issues of mathematics education from the electives to the core subject.

However, as mentioned by senior teachers of this study, it is the inservice program which could help develop more important beliefs, attitudes and classroom practices and to implement new policy initiatives. Although the beliefs held by the practising teachers in this study were consistent with the policy initiatives, a further study would be useful to investigate how inservice professional development might enhance teachers' awareness of their own belief system more strongly.

In recent years, increasing attention is shown on research on teachers' beliefs and the interaction between beliefs and practice as indicated in the Literature Review chapter. It is found from research that the deeply held beliefs of teachers could be barriers to change. These deeply held beliefs might be changed only by confronting them with their professional responsibility. It is through professional conversations that teachers may be pushed to develop their reflective practice which might push their teaching that will change their expectations for students, and that in the process will challenge what they believe and value about mathematics. Studies on teacher thinking also support to the hypothesis 'that being a good thinker is a major component of being an effective teacher. According to Ennis (1987), good thinking is critical thinking and he defines critical thinking as reasonable reflective thinking that is focused on deciding what to believe or do.
Although the practising teacher interviewees in this study made explicit that they valued reflective practice as an important component in their teaching, there were limitations due to the design of this study to delineate their conceptions and actual practice about reflective practice. A study to investigate teachers' reflective practice might shed light to "see" the difference between what they "say" and "do", and this might help them to develop as powerful reflective thinkers and then to develop this in their children.

The beliefs held by student teachers in this study are not as strong as those the practising teachers held. They seem to be of superficial nature. As prospective teachers get an opportunity to rethink of their beliefs in their preservice program, this program might help them develop positive attitudes towards mathematics teaching.

Mathematics is an essential part in our life. It can no more be a boring subject. Children should enjoy mathematics learning. It should be with creative and fun activities. Prospective teachers are also expected to impart positive attitudes towards mathematics in their children. Only prospective teachers with positive attitudes can do this.

Accordingly, the preservice program becomes a main component in a teacher's career. This program has to be well organised and be able to contribute to meet the changing needs of present "teaching force". A further statewide comparative study to investigate the adequacy of preservice programs might shed light to "see" their effectiveness as preparation for teaching mathematics.

This study has provided information and analysis about the beliefs about mathematics, mathematics teaching and mathematics learning held by the practising teachers and the student teachers. At the same time, the study also raised some issues for further research. This study was limited to this extent because of time and resources available. However, the experience gained
through this study is valued as it would be useful in continuing further studies in Sri Lanka, where the researcher is a Lecturer in Education.

Finally, primary mathematics has its place in all children's experience of schooling and plays a main role to prepare children to live in a continuously changing world. Primary curriculum also meets reform changes due to the impact of technology and needs of our lives. However, teachers are going to continue to be the key to successful reform. Teacher knowledge and the tools that teachers use in developing mathematical power in their children are utilised effectively when they are provided with the time and opportunity to use their best thinking.

Although new styles of teaching and new technology will have their impact on primary teaching/learning, Shuard (1986) believes that 'for many years to come, young children will still need to develop their mathematical concepts through counting real things, grouping them into sets, using structural apparatus, measuring, weighing, making shapes, and many other activities' (p.136). Accordingly, mathematics teachers' perceptions about mathematics, mathematics teaching and mathematics learning are important in creating a supportive and innovative learning environment. This study on the perceptions of student teachers and practising teachers is an opening for further research.
References


Department of School Education. (1986). *Guidelines for applications to conduct research in government schools*. NSW: Author.

Deschamp, P. & Tagolini, J. (1983). *Questionnaire design and analysis*. Western Australia: Education Department of Western Australia.


*Undergraduate Degree Information.* (1999). Wollongong: University of Wollongong.


Appendix A: PARTICIPATION INFORMATION SHEET

RESEARCH TITLE: Perceptions of Student Teachers and Teachers in relation to Primary Mathematics

Researcher's name: Thambiaiah Kalamany

Dear Friend,

This research project is being conducted as part of a Doctor of education Program supervised by Dr Christine Fox and Dr Michael Wilson in the Faculty of Education at the University of Wollongong.

This World Bank funded study intends to explore the changing perceptions of teacher trainees and practising teachers about mathematics education. The findings would illuminate the socio-political context in NSW regarding the teaching and learning of primary mathematics.

The participants will be asked to fill out a questionnaire anonymously, which will take no more than 40 minutes to complete. About 12 student teachers and 12 teachers will be invited to be interviewed once only for approximately one hour. Interviews recorded in audiotapes will be used for data collection and analysis only. A report of the interview will be returned to the interviewee to clarify any points made.

The participants of this study will be encouraged to reflect on mathematics education, which would benefit their future teaching. Your participation in this research is voluntary, you are free to refuse to participate and you are free to withdraw from the research at any time. Your refusal to participate or withdrawal of consent will not affect your relationship with the University of Wollongong.

All information will be treated in the strictest confidence. No individuals or institutions will be identified in any report from the project. Data will be stored in a secured cabinet.

This study will be completed by December 2000. If you would like to discuss this research further, please contact Thambiaiah Kalamany on (02) 9764 2827 or Dr Christine Fox on (02) 4221 3882 or Dr Michael Wilson on (02) 4221 3792. If you have any enquiries regarding the conduct of the research, please contact the Secretary of the University of Wollongong Human Research Ethics Committee on (02) 4221 4457.

Thanking you in anticipation,

Yours sincerely

Kalamany Thambiaiah
Appendix B: INFORMED CONSENT

UNIVERSITY OF WOLLONGONG

CONSENT FORM

RESEARCH TITLE
Changing perceptions of student Teachers and Teachers in relation to Primary mathematics

RESEARCHER'S NAME
Kalamany Thambiaiah

This research project is being conducted as part of a Doctor of Education supervised by Dr Christine Fox and Dr Michael Wilson in the faculty of Education at the University of Wollongong.

This study intends to explore the changing perceptions of teacher trainees and practising teachers about mathematics education. The findings would illuminate socio-political context in NSW regarding the teaching and learning of primary mathematics.

The subject of this study will be surveyed with written questionnaires and a selected number of subjects will be interviewed. Data will be presented in a non-identifying way.

Your participation in this research is voluntary, you are free to refuse to participate and you are free to withdraw from the research at any time. Your refusal to participate or withdrawal of consent will not affect your relationship with the university of Wollongong.

If you would like to discuss this research further please contact Mr Kalamany Thambiaiah on (02) 9764 2827 or Dr Christine Fox on (02) 4221 3882 or Dr Michael Wilson on (02) 4221 3792. If you have any enquiries regarding the conduct of the research please contact the secretary of the university of Wollongong Human Research Ethics Committee on (02) 4221 4457.

Research title
Changing perceptions of student Teachers and teachers in relation to Primary mathematics

I, ____________________________(participants name) consent to participate in the research conducted by Mr Kalamany Thambiaiah as it has been described to me in the information sheet. I understand that the data collected will be used in his doctoral research thesis and I consent for the data to be used in that manner.

Signed

__________________________________________________ —

Date

___/____/_____
Appendix C: STUDENT TEACHER QUESTIONNAIRE

Survey Questionnaire

As a component of the Doctor of Education Program, I am gathering information concerning the perceptions of primary school teachers on the teaching of mathematics. The data obtained from the questionnaire will be recorded anonymously. As a participant, you are free to withdraw at any time. If you have comments or concerns about the questionnaire please contact

Thambiaiah Kalamany,
2/7 Hornsey Road,
Homebush West,
NSW 2140.

Ph: (02) 97642827

Of my supervisors
Dr Christine Fox (Ph: 02 42 213882) and
Dr Michael Wilson (Ph: 02 42 213792)
of the Faculty of Education, University of Wollongong

I would appreciate it if you could complete the following questionnaire and return it in the pre-addressed envelope as soon as possible.
Survey Questionnaire (for student teachers)

Part A – Background Information

Please complete the following questions.

1.1 Age (Please circle): <25  25 - 34  35 - 44  45 - 54  55+

1.2 Sex: _______________

1.3 Are you a part-time or full-time student? (Please circle.) part-time / full-time

1.4 What year of the B.Teach / B.Ed are you enrolled in?

1st Year
2nd Year
3rd Year
4th Year

1.5 Employment experience:

Part-time (casual): ___________ Years

Full-time (please specify): ___________ Years
Part B

2.1a What is the highest level at which you have formally studied mathematics? (Please place a tick in the appropriate box.)

Year 10  □
HSC  □
Tertiary Teacher Education  □
Other Tertiary (Please specify.)  □

2.1b If you have formally studied mathematics in HSC, please specify the unit that you have done.

2 Unit Maths  □  3 Unit Maths  □  4 Unit Maths  □

3.1 How much emphasis is placed on teaching mathematics in your pre-service teacher education program?

More than other KLAs  □
The same as other KLAs  □
Less than other KLAs  □

3.2 As a result of your training do you feel that you were able to cope adequately with mathematics teaching in primary classrooms?

Better than other KLAs  □
Same as other KLAs □
Worse than other KLAs  □

4.1 Which of the following statements of the nature of mathematics do you agree with?

<table>
<thead>
<tr>
<th>SA</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Agree</td>
</tr>
<tr>
<td>U</td>
<td>Uncertain</td>
</tr>
<tr>
<td>D</td>
<td>Disagree</td>
</tr>
<tr>
<td>SD</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

Mathematics should be seen as:

<table>
<thead>
<tr>
<th>Mathematics should be seen as:</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A practical way of coping with everyday life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A stepping stone to higher education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A precise discipline for training the mind</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A powerful tool for solving problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A creative activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2 How often would you use each of the following in your teaching of maths? (Please place a tick in the appropriate box.)

<table>
<thead>
<tr>
<th></th>
<th>never</th>
<th>seldom</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Drill and practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Hands-on experiences</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Co-operative learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Journal writing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td>Resource – based learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td>Guided Discovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h.</td>
<td>Regular written tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3 What kind of training do you feel you need to become a competent teacher of primary mathematics?

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maths content - up to Year 6 competency is sufficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths content - up to Year 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths teaching methods - understanding role of maths in society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths teaching methods - integrating maths with other KLA's</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological basis for teaching of maths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Please respond to each of the following statements by indicating the degree to which you agree or disagree with the statement.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too much emphasis is placed on mathematics in the NSW primary curriculum.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The learning of tables in primary classes is essential.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problem solving instruction should emphasise the process of problem solving more than on the product.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Problem solving should be taught as a collection of smaller component skills.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>The school should provide parents with enough information about what children are being taught.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>The school should try to explain to parents some of the modern teaching strategies used nowadays.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>The teacher should give tests to the children at least every week.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>State-wide Basic Skills Test are essential to monitor the children's progress.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Do you have any comments to make about the Maths K-6 Syllabus? (e.g., suitability, interest to the children, ease of use)

Thank you for your assistance. Please feel free to contact me or to add any other comments.
Appendix D: TEACHER QUESTIONNAIRE

Survey Questionnaire

As a component of the Doctor of Education Program, I am gathering information concerning the perceptions of student teachers on the teaching of mathematics.

The data obtained from the questionnaire will be recorded anonymously. As a participant, you are free to withdraw at any time. If you have comments or concerns about the questionnaire please contact

Thambiaiah Kalamany,
2/7 Hornsey Road,
Homebush West,
NSW 2140.

Ph: (02) 97642827

or

my supervisors
Dr Christine Fox (Ph: 02 42 213882) and
Dr Michael Wilson (Ph: 02 42 213792)
of the Faculty of Education, University of Wollongong

I would appreciate it if you could complete the following questionnaire and return it in the pre-addressed envelope as soon as possible.
Survey Questionnaire (for teachers)

Part A – Background Information

Please complete the following questions.

1.1 Professional Qualification(s), Institution(s) and Dates:

1.2 Age (Please circle) < 25  25 - 34  35 - 44  45 - 54  55+

1.3 Sex: ____________

1.4 Years of teaching experience: ______________

1.5 School Classification (Government, Catholic, other):

1.6 Present professional position (Please circle):
   Full-time classroom teacher:
   Casual classroom teacher:
   Executive teacher:
   Assistant Principal:
   Principal:
   Other (Please specify): __________________

1.7 Which group are you teaching at present?
   Year  □  Composite Years  □
Part B

2.1a What is the highest level at which you have formally studied mathematics? (Please place a tick in the appropriate box.)

Year 10 □
HSC □
Tertiary Teacher Education □
Other Tertiary (Please specify.) □

2.1b If you have formally studied mathematics in HSC, please specify the unit level that you have completed.

2 Unit Maths □
3 Unit Maths □
4 Unit Maths □

3.1 How much emphasis was placed on teaching mathematics in your pre-service teacher education program?

More than other KLAs □
The same as other KLAs □
Less than other KLAs □

3.2a As a result of your training do you feel that you were able to cope adequately with mathematics teaching in primary classrooms?

Better than other KLAs □
Same as other KLAs □
Worse than other KLAs □

3.2b Do you think more compulsory time needs to be allotted to maths in your pre-service teacher program? YES/NO

Explain why.

...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................

3.3a How many in-service sessions or staff development days have you attended in the last 3 years?

(i) In school Student (ii) Outside school Student

3.3b How many of them were on mathematics?

(i) In school Student (ii) Outside school Student
4.1 What informs your approach to teaching mathematics?

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncertain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mathematics should be seen as:

<table>
<thead>
<tr>
<th>Stated</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A practical way of coping with everyday life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A stepping stone to higher education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A precise discipline for training the mind</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A powerful tool for solving problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A creative activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2 How often do you use each of the following in your teaching of maths? (Please place a tick in the appropriate box.)

<table>
<thead>
<tr>
<th></th>
<th>never</th>
<th>seldom</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3 What kind of training do you feel is needed to become a competent teacher of primary mathematics?

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maths content - up to Year 6 competency is sufficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths content - up to Year 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths teaching methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding the role of maths in society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrating maths with other KLA's</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological basis for teaching of maths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.1 How much mathematics teaching do you do per week?     mins.
5.2 How homogeneous in math ability is your class? (Place a tick in the appropriate box.)

- Little range in ability
- Some range
- Normal range
- Large range
- Extreme range in ability

5.3 How would you characterise the average ability level in your class in relation to the expected maths outcomes for their age group?

- Remedial
- Slightly below average
- Average
- Slightly above average
- Accelerated

6.1 How would you characterise a typical math lesson - what pattern would the lesson follow?

6.2 How do you generally group the children during maths lessons?

<table>
<thead>
<tr>
<th>Grouping</th>
<th>often</th>
<th>sometimes</th>
<th>never</th>
</tr>
</thead>
<tbody>
<tr>
<td>individual work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in pairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in groups by ability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>collaborative groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>outdoor activities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3 How often do you give homework in mathematics?

- Almost every day
- Every other day
- Twice a week
- Once a week
- Not at all
6.4 In what other ways do you assess the children's progress?

<table>
<thead>
<tr>
<th>Assessing</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>individual portfolios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>attainment tests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>journal observations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>worksheets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>individual projects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>group projects</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.5 How would you rate your enthusiasm for teaching Mathematics compared to other KLAs?

a | Less than any of the others

b | Less than ______________________ or ______________________
   (KLA)                    (KLA)

c | About the same as the others

d | One of my favourites, together with ______________________(KLA)

e | The most enjoyable

f. Please supply 3 suitable key words to describe your level of enthusiasm:
(e.g. worthwhile, boring, productive, difficult, exciting, challenging, useless)

(i) ................................................ (ii) ................................................ (iii) ................................................

7.1 Which of the following do you use in maths teaching with your class? (Please place a tick in as many boxes as are appropriate.)

<table>
<thead>
<tr>
<th></th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape recorder/CD player</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD ROM maths packages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television set</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video-tape recorder /</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worksheets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class text</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyhedrons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base 10 blocks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (Please specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.2 Are you satisfied with the availability of resources in your school for mathematics teaching?
very satisfied □
Satisfied □
Not satisfied □
7.3 What are the most important maths teaching materials you use to teach primary mathematics?

1. 
2. 
3. 

7.4 Why are the materials you listed in 7.3 particularly suitable for your classroom?

7.5 How many computers are available for the use of your students?

In your classroom.. ___  
In another room.. ___ 

7.6 How often do students have access to computers?

7.7 How do you use computers in maths teaching?

7.8 Is there a sufficient variety of maths packages available?

7.9 Who do you go to if you need advice when you are teaching mathematics?

Maths specialist in school /  
Maths specialist outside  
Colleague  
Principal  
Others(specify)  

234
Please respond to each of the following statements by indicating the degree to which you agree or disagree with the statement.

<table>
<thead>
<tr>
<th>SA</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Agree</td>
</tr>
<tr>
<td>U</td>
<td>Uncertain</td>
</tr>
<tr>
<td>D</td>
<td>Disagree</td>
</tr>
<tr>
<td>SD</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Too much emphasis is placed on mathematics in the NSW primary curriculum.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>The learning of tables in primary classes is essential.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Children who use calculators too early will not acquire fluency in computation nor confident recall of basic number facts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Too much attention is given to developing computational ability at the expense of the development of those understandings that are essential to a real insight into mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Problem solving instruction should emphasise the process of problem solving more than on the product.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Problem solving should be taught as a collection of smaller component skills.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>The school should provide parents with enough information about what children are being taught.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>The school should try to explain to parents some of the modern teaching strategies used nowadays</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>The teacher should give tests to the children at least every week.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>State-wide Basic Skills Test are essential to monitor the children's progress.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Do you have any comments to make about the Maths K-6 Syllabus? (eg. suitability, interest to the children, ease of use.)

Thank you for your assistance. Please feel free to contact me or to add any other comments.
Appendix E: SEMI-STRUCTURED INTERVIEW SCHEDULE — STUDENT TEACHERS

1(a) What do you remember about the maths lessons when you were in primary? Did you enjoy them?
   (b) Were you good in maths in High School?

2 What are your beliefs about why mathematics should be taught?

3 What are your beliefs about how children learn mathematics?

4 What are the best ways you use when you teach primary mathematics?

5 How much emphasis is placed on mathematics in your preservice teacher education program?
   a What is emphasized in the core?
   b Have you done any maths electives?
   c Can you explain why you chose this (these) elective(s)?
   d What is emphasized in this?

6 What do you think are the strengths and the weaknesses of the preservice teacher education program in mathematics?

7 What do you know about the NSW Department of School’s Education’s syllabus documents for primary mathematics in terms of outcomes, strategies, content and evaluation?

8 What do you think of the move to integrate mathematics into other areas of the curriculum?

9 What is your opinion about the policy on the use of calculators in primary classes?

10 What would you recommend about teaching primary mathematics if you were asked to suggest a policy for the schools?
Appendix F: SEMI-STRUCTURED INTERVIEW SCHEDULE -- TEACHERS

1(a) What do you remember about the maths lessons when you were in primary? Did you enjoy them?
(b) Were you good in maths in High School?

2 What are your beliefs about why mathematics should be taught?

3 What are your beliefs about how children learn mathematics?

4 What are the best ways you use when you teach primary mathematics?

5 What are the experiences that have led you to choose these ways?

6 Have you changed your views on teaching and learning of mathematics in your years as a teacher?

7 In an ideal world, how would you like to teach mathematics?

8 What are the things that might prevent this?

9 What are the areas you most agree of disagree with or disagree with the NSW Department of Education's policy and syllabus for mathematics?

10 If you were asked to suggest changes to the syllabus what would you recommend?
Appendix G: BACHELOR OF EDUCATION/TEACHING

Primary Education — Subject Description

EDU102 Mathematics Education I

Spring

Contact Hours: 3 hrs per week.

This subject focuses on the teaching and learning of K-6 mathematics, based on the NSW K-6 syllabus and the National Statement on Mathematics. This subject requires the students to develop a rationale for teaching mathematics, to examine approaches to teaching the content of infants and primary school mathematics, and emphasises the theoretical underpinnings both of the structure and sequence of the curriculum, and of specific and of specific teaching and learning strategies.

EDUM224 Mathematics Education KLA Elective 1

Spring

Contact Hours: 3hrs per week

This subject will focus on the development of content and activities for teaching units and extensions of the K-6 Mathematics syllabus. Topics include topology, tessellations, number patterns, fractals, probability, geodesics, polyhedrons and mathematics in our environment. Students will be expected to present an overview of the extension strands and prepare a sequence of lessons related to them.

EDU333 Mathematics Education KLA Elective II

Autumn

Contact Hours: 3 hrs per week.

This subject will focus on the underlying issues, which have been given emphasis in the structuring of the mathematics K-6 syllabus and the National Statement. Areas to be considered will include technology, language, gender, multiculturalism, problem solving, attitudes to mathematics and children with special needs. The subject will extend the work done in EDUM 102.
Appendix H: EXCERPT FROM INTERVIEW WITH SP2

Q: What do you remember about the maths lessons when you were in primary? Did you enjoy them?
A: When I was in Primary school, maths was very much from the text book and we had a mental text book and also an LEM text book Let's Enjoy Maths, and always it was a case of saying 'Now open up to page so and so and we'll do this,' and a brief explanation was given and you simply worked from the book. It was very boring. There were no concrete materials, so I would imagine that the children who didn't understand would have problems with it and that after that we'd turn to the Mental page and we'd do some of that and also we took the books home and we did some for homework as well. So, I don't have fond memories of Primary school maths, from my experience, because it was boring.

Q: So were you good in maths in High School?
A: Hmm I'm trying to recall. For the HSC I did 2 Unit Maths. I couldn't tell you my mark exactly. I think it was 82 or something like that, so I was above average and maths.

Q: What about the background of your family in maths?
A: In maths- my mum started out as a High School Maths teacher, which meant that I could ask her any questions that I wanted. That was good! She went on to become a Maths Teaching Lecturer at Kurringai and ETS, so that when I was going through Uni. And learning to teach mathematics, she could help me with that as well. That was really good! She has also gotten involved in Gifted Talented Maths Groups as well as Remedial Maths Groups- she did some volunteer work and so I find always with teaching, I'm getting ideas from her and lots of resources again, from her, so that's great. My dad is a High School Teacher, so he doesn't like maths at all and my sister is really good at maths. She did 3 Unit Maths at my school, but she never really used maths in her career. My brother, no he was not good at maths, so he has not used it in his career, either.
Q: Anyway, you are teaching maths now, so do you feel that you didn’t get any motivation in your primary school days?
A: No, that’s right. I didn’t enjoy it in Primary. I didn’t enjoy it in High School. Then I started to enjoy at Uni, because suddenly I discovered that there was a whole new work of concrete materials and.

Q: What are your beliefs about why mathematics should be taught?
A: Ok. Hmmm I think that mathematics should be taught so that ultimately people can function effectively in society. This means that not only can they function in various occupations or professions, but also in everyday life. Maths exists all around us and everywhere we turn, whether to do with driving to work or whether it’s to do with shopping or even hobbies—everything has to do maths, ultimately.

Q: So, what are your beliefs about how children learn mathematics?
A: Hmm My beliefs on that would be that children learn at their own pace and individual differences need to be catered for and hence we need to have different ability groups within the room. I also believe that concrete material play an extremely important role in learning maths and also strongly believe that the children enjoy maths as well and we can provide for that area by having fun activities. For example, if you are teaching a instead of a basic worksheet, turn it in to a game with a group, and so on Yes. Those believe I apply to all the classes—all the grades in Primary, so for example, with Year 6 I would do just as much concrete material work and group work and so on.

Q: So, in your class, do you think that the children learn mathematics very interestingly?
A: Yes, Yes.

Q: Because of the games that you do, isn’t it?
A: Yes, it’s because of the variety. I think that they enjoy the textbook that we have got as well — Step ahead with Maths. We use it in a limited kind of way and we use it in a balanced way, so it’s supplemented by hands-on rather than games and group work, and also the textbook that we are using now is much more interesting than the textbook that I used at school, and it calls for concrete materials. Although you might have the children at the desk with pen, pencil and textbook, they’re also using the concrete materials with the textbook.
Q: May I ask you one question, which is similar to this. What are the best ways you use when you teach primary mathematics?

A: I'm just thinking how I can add additional information. Hmm At the end of the year, by assessing the children where they are in maths, I put them in ability groups, so that they are working at their level and then I do the balance textbook and hands-on group work. We are just starting a program coming into- I'm not sure if other-I think the schools in the Granville district are just starting it as well as some other schools. It's new to us in the Primary. Last year Kindergarten to Year 2 began it and next year Year 3 and 4 are beginning it, and we have just started making the resources. It's a lot of hands-on thinks. Mainly games and we started the first a lot of hands-on things. Mainly games and we started the first lesson last Monday and if it went really well. The children were very motivated and inspired by the different activities. They are very appealing. They are brightly coloured. They've got lots of different resources- little plastic frogs, counters and dice and all sorts of things and the children absolutely love him.

Q: What are the experiences that have led you to choose these ways?

A: Ok, Hmm In my early years of teaching, especially the first three or four year 2, they attended a lot of training courses and inservices and they led me to choose these different ways. To a certain extent, at Uni. I learnt how to use concrete materials- how to use group work to the best extent and also general experience- seeing what the children responded to and enjoyed and did well from. They are the main things, I think, that influenced me.

Q: What about using problem solving?

A: Yes, problem solving and open-ended questions. Definitely. A textbook doesn't cater for that so much and there is not so much problem solving. However, I get a lot of problems solving resources from Mum and open-ended questions that I use in group situation and the children really love the challenge of it.

Q: So, do you give them enough time for them to get into activities?

A: No, No. For problem solving? No. I think that at this school we feel the pressure to get the text book completed by the end of the year, so we have to allocate enough time for
that, because we feel that to send home a text book that is only partially completed, is saying to the parents that we haven't been doing enough maths.

Q: Do you give any opportunities for the children to reflect on their learning?
A: That's a good question. We intend- at the conclusion of the lessons, I get to put their hands to indicate how many they got right, and also whether they think they have tried their hardest and whether they think they have achieved well in that lesson, but no, I don't allow time to discuss and reflect on what we've done and learnt. More or less, what I do is just a very quick OK, haven't you got all of them right. Have you tried hard? Are you pleased with your achievements? In answer to your question, No, but it makes me think that it probably would be valuable to allow time to reflect on what we've done.

Q: What about asking them to write a journal?
A: I have had it suggested it in one of the courses that I did.

Q: Have you tried that?
A: I can't remember. Yes. We were looking at volume and they had to- it was more a homework task. They had to fill a bath half way with water and then get in the bath and look at the displacement of the water and then they had to record the information- how they felt was appropriate and then they had to write about it. No, it wasn't a journal as such. In fact, it was just a one off activity they were writing about, so on; I've never kept a journal.

Q: So you mean that for maths, journal writing is not appropriate?
A: Oh no! I'm not saying it's not suitable. It's something that I've never done, purely because, I think it's a time factor at it's difficult to get enough time for that extra component of maths. However, a way of doing that would be to integrate it with writing and see it as a writing lesson as well as a maths lesson.

Q: Have you changed your views on teaching and learning of mathematics in your years as a teacher?
A: Yes, I'm sure I have-now, how have I changed my views?

Q: For how long have you been teaching?
A: This is my tenth year, so it is a fair while.

Q: The best way is to ask you is whether you have changed your views over the years?
A: Right. Right. I think, in fact, I know, I was very idealistic, and I thought that concrete materials and group work are also important. We should always be doing that, but, for example, last year I had an extremely poorly behaved class, and I had to accept that group work with concrete materials was not the best way to teach maths in that room, because behaviour problems were quite bad, but to use group work and concrete materials regularly, it just didn't work and the children can be extremely disruptive and use the resources in the wrong way. I'm talking about throwing them and things like that, so I came to the conclusion that it's not the ideal world and we can't use group work and concrete materials when we feel like it, do therefore, in some cases to use a text book for 90% of your maths program is just something that you've got to do. I wouldn't do that readily, but I would do it when the necessity is there.

Q: In an ideal world, how would you like to teach mathematics?
A: In an ideal world? Well, I know that when I have support teacher assistance, for example this year I have an integration aid. She comes in because one boy in my class has behaviour problems and know that when she is there and she is taking a group, that it enhances what the children are learning. It makes it easier for me, of course, and more beneficial for the children, in the ideal world, I and me with one of them. would have if I, for example, got four groups of children, in an ideal world I would have an assistant for three of them and me with one of them. In the ideal world, of course, I would have smaller classes and more time to analyse the children's abilities, prepare the lessons and make or gather concrete materials and what else? There are lots of things. I wish it was the ideal world. In the ideal world, we would have far more resources, more fun things for mathematics. I know that, at this school, for the last three years we haven't had any money spent on maths resources, which is very disappointing, and it wasn't until the year with a new principal and a new Deputy, that we have had a decent amount of money to spend on it, so, of course, financial backing is really, really, important and in an ideal world, we would certainly have a lot more that we do. I'm trying to think of other things. I'm sure there are a lot more things. So, therefore, more assistance from support teachers, more resources and smaller class sizes. I think they are really important.
Q: How many students do you have in your class?
A: This year actually, I have smaller class with only 26; I think it is, with kids going up and down regularly, because we have a very unstable community problem.

Q: Do you have an ideal number that you would like in the class?
A: An ideal number would probably be- for example, I taught in a Private Scholl in Holland and we had 18 children in a class and suddenly found it very manageable. I could really reach the children. I could assess them very accurately. I could report them much more accurately. I could teach them in a far more direct and better way, so 18 would be the ideal number, I think.

Q: What about integrating maths into other subjects and all the subjects together?
A: I integrate a lot of subjects. I find it easier to integrate English with subjects like science and Human Society and its Environment and so on, but although in my earlier of teaching, I tried to integrate maths to a fair level, now I don’t, and especially at this school, where it’s stated that we will use textbooks. That is not the teacher’s decision, from my understanding, then it is very difficult, I find, to integrate maths with curriculum and so I must admit that I don’t integrate it hardly at all. It might be a tone off lesson occasionally that if feel relates to your topic. Actually, in an ideal world everything will be linked and integrated- all the subjects. You would just have one theme and your maths and your English would be derived from that theme and support that theme. I’ve spoken to people who do that, and the children then become engrossed and immersed in this theme and everything links and everything makes sense to them, but the difficulty with the fact that with the Syllabus you would have, you would have to keep track of what you are doing, rather than just looking at the scooping sequence for your school and ticking it off as you go, you would have more bits and pieces that you would touching on and recovering and coming back to. I think that would be the difficulty-keeping track of what you’ve covered and what you need to cover. It would be less straightforward than say working through a maths textbook, where it’s all just laid out in front of you.

Q: What about involving parents in your teaching in an ideal world?
A: Yes actually parents can make wonderful support people in maths classrooms; especially with group work and I’ve had some very good experiences with parents support. I’m finding that at Auburn Primary, I think it is 94% non-English speaking
backgrounds community, and therefore, parents that speak fluent English are not easy to find and also the parents, although they might be fluent in English, they might not have the confidence to come into the classroom and help, so therefore at this school there isn’t much parent participation in the classroom, unfortunately.

Q: So what are the things that might prevent your way of teaching in an ideal world?
A: Things that prevent my ideal teaching of maths ...financial backing. Of course, funding is always very limited and also availability of parents to help and availability of support teachers to help. Behaviour of children is an important factor. Children don’t behave like they would in an ideal world.

Q: So, how do you want them to behave?
A: In the ideal world, they would be focused on the task at hand and they would be enthusiastic, which I realize; can promote enthusiasm to the best of our ability, but not all children have great enthusiasm for maths. They would be settled. They wouldn’t want to disrupt other children learning maths and with those factors they would better learn.

Q: So what are the areas you most agree of disagree with or disagree with the NSW Department of Education’s policy and syllabus for mathematics?
A: The syllabus, I think is wonderful. I think it is very structured, first of all-easy to read, easy to locate the information that you are after and on the bottom of each page, the suggestions, the ideas, the activities are really good. Activities that you don’t have to worry, Oh, am I going to be able to find the resources for it. They are readily available, the resources they suggest and they are easily implemented in the room, so there are the main things I like about the syllabus. The NSW Department of Education’s Policy, to be honest, I don’t really know, I’ve been out of the country I was here last year, but the three years before that I was teaching in England for two years and then Holland for one year and, therefore, I’m not up to date with their policy on maths. I’m only up to date with the syllabus, I, strongly in favour of.

Q: What is your idea about the Basic Skills test that is conducted?
A: OK, The Basic Skills test, I don’t think addresses the fact that there are so many non-English speaking background children in schools like Auburn and so, therefore, I don’t think the Basic Skills test is a great relevance to our children. I think that when the
children-or when the parents get the result, I know at our school-we don't promote those results in a big way, because we feel that it is just not appropriate for communities like ours. We have a lot of children that sit and they can't read the questions. Of course, the question-there are so many of them and you need the English to be able to do the maths and so a lot of our children have trouble with it. We feel it's better to assess the content of the syllabus the way the children can do those tasks in the classroom, as opposed to a basic skills test, which is a one off test. I know that a lot of schools spend a great amount of time preparing for the Basic Skills test, but we don't feel the importance of it here. We simply give the children enough practice so that they don't feel daunted by completing the test. They don't feel anxious or worried, but we don't spend a lot of time on it and we don't value the results so much here.

Q: If you were asked to suggest changes to the syllabus what would you recommend?
A: Ok. I would want to see it's new outcomes and indicators integrated with Maths K-6 syllabus such that it's not a case of, for example, as the moment we have Syllabus and separately we have the outcomes and indicators for maths, and you have to use both and interrelate them, whereas I would like to see in the future, the objectives in the maths syllabus which has now effectively been outdated. The term objectives have gone- it's outdated now, so I would like to see the new maths K-6 outcomes and indicators integrated in the syllabus. That's the only change that I'd like to see.

Q: What's the reflective practice you use? How do you reflect on your teaching?
A: That's a good question. At the end of the day I have to say not at the end of the lesson, as I would like, but at the end of the day, I would tend to look at where the children got up to, where their understandings were and what they have achieved and I would use that knowledge to then plan the next lesson the next day. So I would also consider the children's enthusiasm and enjoyment of the lesson. I think that is very important.

Q: Do you write a diary or journal?
A: I don't keep a journal or anything similar In relation to maths, if a child is being badly behaved, I would just use the discipline structure that I have set up in the classroom, whereby their name would be removed from the Behaviour Chart from a happy face to a sad face, and generally they respond to that and then they would get back onto their
maths. That would be fine, otherwise I might remove the child and they would do their work separately, although I don't really like to do that. That's for behaviour. With regard to achievement, it felt that a child wasn't achieving, I would have to readdress the way that I'm teaching and may be use additional concrete materials or different materials or a different strategy to cater for them. In reflecting, we keep a program of all the key learning areas and the way we are teaching them and they are the section for evaluating and so write a small amount on how we think that units gone with the children.

**Q:** Is that for your own recording or for the school?

**A:** We do it as a school. People have different ways of doing it and some people write fairly extensive amounts, and other people prefer to write limitations, but for me, personally, I complete it and I don't really need to write it down and I feel I'm just writing it down for my supervisor in that situation. I do like to have a check list of what the children have completed and what the children have achieved and so on and so forth, as well as an assessment folder, but that's about all.

**Q:** So of you need some advice, where do you go?

**A:** I generally go to my mum to get advice, because I feel she has a lot of experience in many different aspects of mathematics, not just because of her profession of being a lecturer, but also because of her experiences as a teacher and I guess, although with other subjects I would tend to ask people here, with maths I don't, I ask my mum, because I feel that she's got the best knowledge.
Appendix I: EXCERPT FROM INTERVIEW WITH S41

Q: What do you remember about the maths lessons when you were in Primary? Did you enjoy them?
A: They were graded so that we were in the top class, middle class, the bottom class. We went in maths competitions all the time. We weren't allowed to use calculators at all and we had different teaching. I can't really remember basically we did mainly that and a lot of mentals. We were forced to stand on tables and say mentals and if we got them wrong we were sent out.

Q: Did you enjoy?
A: Sometimes. If I didn't have to stand on tables I was all right.

Q: Were you good in Maths at High School?
A: Yeah, I suppose. I didn't do the highest maths or anything, but I was pretty good. I did Maths in Society.

Q: What about your family background? Is there anyone good at maths?
A: My dad only went to year ten, but he was pretty good at Maths. He was great, a construction builder that kind of thing he designs. But, he is not an architect and my mum was o.k. She was all right at it.

Q: What are your beliefs about why mathematics should be taught?
A: Because they are going to need it in High School, they are going to need it outside school, in their work. They need it for everything, even going shopping yeah, basically.

Q: What are your beliefs about how children do Mathematics?
A: By doing it by giving lots of activities where they can play with concrete mathematics. Just sitting doing the kind of like maths mentals, maths class, I don't like that but they're good for revision and, you know, checking outcomes that kind of thing (What else? ok) Yes, just by being involved in it by doing things Yes, practical work.
Q: What do you believe are the best ways of teaching primary mathematics?
A: Practical activities where, say, talking about polygons like regular the polyhedra the shapes I like 3D shapes and instead of them looking at a book and making things I did an activity where they make a city out of these shapes they could triangles and the houses they make out of squares, cubes, and triangles. They make it out of paper themselves; they decorate them, and then make a little city out of it instead of just looking at a book.

Q: Would you use problem solving as a strategy to teach primary mathematics?

Q: Would you emphasis on process or product?
A: Process. I mean product is important but I mean if you look at the way they did it then you can see where they are getting their wrong answer and where they’re actually having trouble with them.

Q: How much emphasis is placed on mathematics in your preservice teacher education program?
A: Yes, say, not a lot. No more than any other subject, but in the school, we got to teach it everyday every single day and most subjects are taught once a week. May be twice a week, if you are lucky but here it’s not emphasised. It’s an elective. You only have to take it once.

Q: What is emphasised in the core?
A: Yeah Problem Solving, numeration, just all things in the syllabus Teaching alternative ways like using lots of tessellations using match stick figures, not teaching straight from the syllabus outcomes that’s about all I can think of that.

Q: Have you done any maths electives?
A: Yes. I have done, two of them. Mathematics electives one and that was Teaching Strategies where we learn different ways of teaching in maths, apart from the syllabus and the second one was Issues in Maths where we looked at gender, multicultural
perspectives aboriginal perspectives and had to teach for those kids and cater for them.

Q: Can you explain why you chose these?
A: Well, the first one I chose, cause I thought it was easy and I was um second one I did the something. The second one I did that was harder a lot of harder. We had to think a lot.

Q: Are you interested in teaching maths?
A: Yeah, yeah, I like maths.

Q: What do you think are the strengths and the weaknesses of the preservice teacher education program in mathematics?
A: Strengths um more on practical In 1st year we talked about syllabus and how to teach addition and that kind of thing which was really good because it showed us a sequence of how to teach things in the syllabus they taught us. We actually had to do maths we had to pass an exam to go on with the subject and to make sure that we were actually any good at it that was good Then, we in the second elective was good because it was more on teaching strategies but from the first elective no one wants to take again because we couldn't do too much on it the third one was just I thought it was interesting but it was irrelevant.

Q: What are the weaknesses?
A: Weaknesses In the first compulsory subject wasn't enough on teaching strategies and there needs to be a lot more on that but it's hard too because he had to teach the sequence of it. The second selective, I thought, that was excellent, you know, it was really really good. The third one, like I said, I didn't find it that great, but we have to do one assignment where we had to review a section of software or a textbook and that was really good because we had to look for the strengths and weaknesses without any bias or anything, yeah.
Q: What do you know about the NSW Department of Schools Education syllabus documents for primary mathematics in terms of outcomes, strategies, content and evaluation?
A: Outcomes They are divided into three strands: measurement, space, and numeration, and in those you’ve got addition and subtraction, multiplication, division, and positions, graphs. Then, it’s student-centered. It’s focused on what they can do at the end of the lesson. Strategies a lot of them are context in contextual they have put in what kids would consider relevant to them, the practical, a lot of them, then a few tests like pen and paper tests, yeah and strategies.

Q: What do you think of the move to integrate mathematics into other areas of the curriculum?
A: I think it is good, but it’s very difficult to do like, you can’t integrate maths with everything. You can put it in that setting so you could teach anything about rainforest so they can measure the area of the leaves in rainforests. I don’t know you can do that sort of thing, which is using examples of trees or whatever. I think it’s a bit silly.

Q: What is your opinion about the policy on the use of calculators in primary classes?
A: I think it’s good, but they should only be used once they got the concept of, say, subtraction. They know how to subtract so they just use it when they are using big numbers to make it quicker. They need to be aware that sometimes your brain is a lot quicker than using a calculator.

Q: What would you recommend about teaching primary mathematics if you were asked to suggest a policy for the schools?
A: I have no idea.

Q: What is your opinion about the importance of reflective practice for teachers?
A: Yeah, so they can see where the kids are doing ok, where you are doing ok, what needs to be improved, whether that lesson works because what works with one class might not work with another.

Q: How would you reflect on your teaching?
A: You can use a daybook and just write down or in your program what worked, what didn’t what you can improve on, just in your program. You could just think about it you could have a journal.

Q: What is your opinion about asking primary children to write for learning maths?
A: Yes, they can be asked to write a journal, but I haven’t done it though so like they can reflect on their learning what they have learnt, whether they like the lesson that also helps you with your evaluation.

Q: What did you do in your practicum? Did you change your views after the practicum?
A: Oh, yeah a little bit because in my first prac, it was very practical and hands-on. They had a lot of activities and the second one was in between. They did a lot of prac and the last one I did it was all out of Maths Plus books, that’s it. They don’t do any work with anything. They don’t go out of the classroom. They sit at their tables. They don’t talk, they just do it.

Q: What is your opinion about involving parents in teaching?
A: Have an information night at the beginning of the year. Tell them the kinds of things you’re going to do things to be done in your classroom the kinds of activities how to be set up when you’ll be having parent-teacher interviews. Bring them in. Show them work samples of their children’s work so they see what they are doing at the beginning of the year and at the end Also homework. They have to help them with their homework so you just send it home.
Appendix J: EXCERPT FROM COMBINED CODED INTERVIEW

CA/SI1 I have actually done a course with parents in literacy for them to be able to help the students in the school. But, I haven’t found so much in the area of mathematics courses that would be helpful to parents. Courses that are available to teach parents in terms of how to help their children at school, but I think it’s a great idea.

CB/SI2 I’ve thought of many different things about the Basic Skills Test. I think it is a good idea where the teachers are able to see where they’re at, what they know, and what they don’t know, but I think it is very wrong when schools and media gets involved and says the children from the North Shore got this result, and the Out West children got this result. Why is that? I think that is very wrong because it should be a test that is just for that particular child to see what they know, rather than comparing schools.

CC/S43 I think it’s essential in the sense that children need to know how to use calculators properly and effectively, not just to find answers to the questions so that they’re not thinking themselves, I think it’s important to use calculators where children are still encouraged to think and act mathematically.

CC/WP2 The syllabus is one of the best documents the Department has produced one of the best to use. It’d be the most used document in the schools. I’d say, because it’s practical. You can actually go to a page, read what you have to do for the grade or that particular stage, it gives you some activities
for it, what’s what, what to assess, what to evaluate. It’s all set out really well.

CI/S12 I think it’s very important that integration occurs, because it also provokes greater interest in other KLAs and it doesn’t mean that maths is such a dry subject. It can be incorporated into, you know, greater themes of what children were studying, so they reflect greater enjoyment in doing those things than sitting on the table everyday at 11 o clock copying 10 sums from the board.

CI/S43 I think it’s great if it can be done without losing integrity for the maths subjects. If it’s done in a way that it’s going to undermine the concepts that’s being taught, then it shouldn’t be done only to be done if it’s not going to detract from the mathematics taught. So, yeah, I think with any Key Learning Area it is great to integrate because of the time restrictions placed on teachers, it’s something that need to be done.

CI/SP2 But the difficulty lies with the fact that with the syllabus you’d have, you’d have to keep track of what you are doing, rather than just looking at the scoping sequence for your school and ticking it off as you go, you’d have more bits and pieces that you would be touching on and recovering and coming back to. I think that would be the difficulty — keeping track of what you’ve covered and what you need to cover. It would be less straightforward than, say, working through a maths textbook, where it’s all just laid out in front of you.

CI/SP2 I’ve spoken to people who do that, and the children then become engrossed and immersed in this theme and everything links and everything makes sense to them.

CI/WC1 I believe that you can integrate maths in many areas, anyway. A lot of problem solving — you have to be able to do well in English to do problem
solving, anyway. Children can't do maths unless they can read and write, especially problem solving. If you ask children a problem and if they don't have a good grasp of English or comprehensive skills, they won't know what the problem is asking of them.

**CI/WC1** But there are lots of things that you can do and we tried to integrate as many KLAs as possible into as many different ideas. I mean it's not always possible with maths, but there are some instances where you can and the kids seem to benefit too, because it's not just mathematics this time or English this time, it could be all integrated.

**CI/WC2** Oh, I think it's very important and I think there are lots that can be done within that. We went outside, a little while ago and we had a sports lesson in a sandpit outside, with long jumps, and we turned it into a measurement. We took our containers and we measured and emptied half-filled, and did all sorts of things, which was great.

**CP/S33** A lot of time, the product is wrong because the process is wrong. So, if the child understands the process, then more likely to get product right.

**CP/SI3** By setting up a situation where they have to discover, they have to solve a problem, so the teacher might pose a problem. A discussion might follow. Various brain-storming activities might take place where they suggest ideas, and then they get an opportunity to experiment with those and see whether their ideas are going to work or not... If we can pull our ideas together and come to a conclusion and say, well, as a result of what we have done, therefore we have seen that this process works best. Is there a rule that we can apply there? Is there some learning that we can put into practice?
CP/WP2  Process does take a lot of time. You're wasting a lot of time in class to do it. Then often you'll jump back to the simple old drill because it's a bit quicker.

CS/S12  The syllabus, I think, is wonderful. I think it is very structured, first of all, easy to read, easy to locate the information that you are after and on the bottom of each page, the suggestions, the ideas, the activities are really good activities that you don't have to worry. Oh, am I going to be able to find the resources for it? They are readily available, the resources they suggest and they are easily implemented in the room. So, they are the main things I like about the syllabus.

CS/WP1  I like how it's set up, strands and the set up at the beginning. Numeracy, addition for K, language, this is what you should use, these are the outcomes you should achieve. Everything is very set out and easy to read. Pick and choose what you are going to do, make sure you get space areas, numeracy, measurement well laid out, easy to read. Read it for ideas and integrate ideas.

EA/SI3  I think that they learn by doing. They learn by experience. There are some things, I guess, that they need to learn by rote... I think that they learn when they are ready and when they have had the appropriate experience. They understand the concept involved and learning happens and if a teacher is lucky enough to be able to capitalize on that experience, that's wonderful.

EACF  I enjoy maths, yeah. It's so diverse now. Usually, it was just all paper work, just doing sums and now it's getting kids to do things and group works really enjoyable. Kids love doing those things — things like floating in the tank, weighing things, sliding things or checking things. Yeah, it's hands-on.
EAD/S21 I think they learn through experience and experimentation. So, if they can see a purpose for using it, and if they've used it before, I think that's good, and if they can experiment how to use something so rather than doing sum on the board or something they could do a practical means for using it.

EAD/SP3 The younger they are, the more they need to manipulate materials and discover for themselves and learn. The more they discover, the more lasting that's going to be. They will remember that rather than what they have been told.

EAD/WC2 A lot of things Yes, I have made myself a lot of things. From my own children at home, like toys and things, counters and things I have brought them along, because unfortunately we don't have a great deal in the school. We are very limited in resources. They are trying very hard to get more, but and then I suppose there are lots of things. I remember collecting shells from the wharf side, rocks and pebbles, and all sorts of things, just to help them with their maths and their counting and in their numeration and things like that.

EAD/WC2 There are some children who are very, very bright and they are going to get it regardless. But for the majority of children, maths is a difficult concept, but if it's explained they can discover and they can put their hands on things and work it out themselves, they are going to always remember that they have to learn by seeing, by experimenting, by discovering.

EAF/S12 I think by making it fun, not just sitting in the same position everyday, same time, writing the problem on the board and solving them individually... I think a bit of group work is necessary. Teacher needs to find out where
individual students are and how individual students are coping with mathematics the people that need more help find out what motivates children to be able to learn mathematics to make interesting and maintain their interests, otherwise it’s boring.

EAF/S11 I think that often we just emphasise numbers and abstract symbols and we give the children worksheets to work on with lots of operations and lots of pluses and minuses and time tables, but not so much the opportunity to play with the objects and also mathematical games — games that are based on mathematical concepts so that they get fun and enjoyment, I think they are essential throughout schooling. They help a lot.

EAF/S12 We have a lot of different toys that the children use, construction toys or counters or blocks. They have a lot of those available for their use. Children, especially love making towers and learning all of the maths ideas that come from construction towers. They really enjoy maths time. It’s a fun time for them in Kindergarten.

EAF/SP2 I also believe that concrete materials play an extremely important role in learning maths as well and we can provide for that area by having fun activities. For example, if you are teaching a topic, instead of a basic worksheet, turn it into a game within a group, and so on.

EAF/WP2 Yeah Usually it was just all paper work, just doing sums and now it’s getting kids to do things and group works really enjoyable. Kids love doing those things.

EAG/S22 Probably group work and activities and trying to get if possible like parent helpers to come in and do rotation work where one group might be doing something en masse and they are using spring balance and another group
might be doing something on length and they've got metre rulers and them are measuring things. I think, very, very hands-on. So, give them all the maths equipments and set their task to go out and use these equipments.

**EAG/SP2**
My beliefs on that would be that children learn at their own pace and individual differences need to be catered for and hence we need to have different ability groups within the room. Those beliefs apply to all the classes — all the grades in primary. I would do just as much concrete material work and group work and so on.

**EAG/WP2**
I have groups, sort of all around the class with a mixture of kids in each group. Rather than all the brains in one group and all the kids that need help in another, I ask the kids that are good ones to be the professors and I ask them to help the kids that needed the help. That way they are being taught on a peer basis. Not just sitting there and *acting like vegetables, they feel they like maths a lot more*.

**EAR/S43**
I think that children are learning in so many different ways, what works for one may not work with another. However, I think that in the early stages, it's particularly important to have the use of concrete materials and also that's important, when children are learning mathematical concepts, that they're related to their everyday life so that they can see the relevance of it. Why it's necessary to be taught for their own benefits for their own capacity to function in day-to-day life with the maths that they're learning.

**EAR/WP1**
If you can relate it to everyday life, they say, Okay, I'll learn this cause I see why I need to learn this. You're doing a topic and it might be boring and if you don't let them do hands-on or relate it to everyday life, they've a kind of go in one ear and out the other and they are not that excited about it and
they learn it just to pass a test or something. I find that children, if you’re doing something with shapes and measurements, you’ve got to get the measurement equipment out; you’ve got to get the shapes out. If you’re doing numeration, you need to go to the store to add and subtract and multiply, relate it to everyday things so that kids can understand why it’s important. Otherwise, if they don’t see any use of it, they don’t try.

EAT/S32. I probably think, this is because of my own negative things I got from primary school so, I would probably think they learn the best from using hands-on equipment. Like, it’s fair enough to use textbooks and stuff like that as a back up, but I certainly think their needs to be teacher instruction. Probably peer collaboration, group work that sort of thing and I think there has to be individual learning and that can be done using the textbook, perhaps.

EAT/SP2 I think that they enjoy the textbook that we have got as well — Step Ahead with Maths. We use it in a limited kind of way and we use it in a balanced way, so it’s supplemented by hands-on rather than games and group work, and also the textbook that we are using now is much more interesting than the textbook that I used at school, and it calls for concrete materials. Although you might have the children at the desk with pen, pencil and textbook, they’re also using the concrete materials with the textbook.

EAU/WC3 I found out that the probable best way, through experience, is hands-on methods using concrete materials, specially with the younger children or even with the upper primary children who are experiencing problems in understanding the concepts. It just gives them a chance to get a feel for the concepts, they need to understand. You can use a variety of techniques whether it’s extending their mind through computer software or through extension activities.
EAV/Si1 I believe that mathematics should be taught with a lot of practical stuff — a lot of hands-on concrete objects so that the students can visualize the concept and not go into abstract thinking before they have a base of knowledge. A really stable and thorough base of knowledge with concrete materials and the objects that they can use.

EAV/WC1 To teach primary mathematics, especially being a kindergarten teacher, I use a lot of hands-on materials. The children don't understand unless they see it. They need to see the visual aspects of the concept that you are trying to teach.

ED/S23 Things like times table... I think, really it has to be drill because I know that we drilled our times tables that's really the only way I remembered it. I think that if the teacher can make it interesting, not just open the textbook to this page and do that, I think that would have really big effect on actually how they learn it. Because I think it's important that they should retain it in their memory and if it's boring then they'll just do it to get it done, sort of push it away then.

ED/S33 Probably, drill and practice comes into it sometimes.

ED/SP3 But I believe there is a place for rote learning though. There are some facts that must be learnt all the time, but makes the foundation — the basis for the mathematics knowledge and from then only they use that in whatever they are doing.

ED/WP2 Usually I was taught by practice and drill. Better is by doing practical activities like they should go out and using the things, picking up things, lifting things, weighing things and measuring things, which is great. But, I find now is that I need both. I need to have some basic drill like basic sort of just going over it quite often and the activities as well, not just one or the other.
To set up the situation, perhaps in the classroom, or outdoors, so that they can discover for themselves. I guess sometimes it’s contrived because you want them to discover some particular thing, so if you set up the problem, or you set up the situation, pose the question and then provide them with the materials they can experiment with and make a discovery.

They are usually better at learning maths than anything else. Usually, it’s their language related subjects like writing and reading that are more difficult for them. Mathematics, if you just go by operations and facts, they do very well in that area. They have difficulty in space and measurement because there is a lot of language involved in that, like heavy, light, long, short and so forth, so that it’s more different for them.

Ideal world will put us into a situation where we have all the aids, all the assistants, and all the equipment that you can get. You have a small class load, one-on-one with student where you have a greater success rate as opposed to having a classroom where you have mixed ability groupings, teaching to different levels within your classroom, obviously those aspects would not come into play in the ideal world.

If children are misbehaving, and then teachers often don’t want to give them exciting activities because the children could misbehave.

Last year I had an extremely poorly behaved class, and I had to accept that group work with concrete materials was not the best way to teach maths in that room because the behaviour problems were quite bad.

Behaviour of kids these days prevents a lot of good teaching going on.

An ideal number would probably be, for example, I taught in a private school in Holland, we had 18 children in a class, and suddenly I found it very
manageable. I could assess them very accurately. I could teach them in a far more direct and better way, so, 18 would be an ideal number.

FCS/WC3 I guess definitely it's the politics. You can't have smaller classes in situation like Wollongong I guess it's the politics of having to have a certain amount of children in your class.

FF/SI1 Lack of resources and that comes from lack of knowledge of how valuable these things are. I guess unless the school realizes how important games and concrete materials are to teaching, they will go back on using worksheets, because it's just an easy thing to do. Put a worksheet in front of a child. That will keep them quiet for the next half an hour working on it. It is much more difficult to think of creative ways in which to teach them.

FF/SI3 Yeah, it's just money yes, all those things cost money.

FF/SP2 Things that prevent my ideal world teaching of maths yeah, financial backing. Of course, funding is always very limited.

FF/SP3 Money — government money. They are spending millions on the Olympic games and what do we get — nothing and we have to fight for everything we get — even our wages we have to fight for. So, they are not going to give away money for some ideology that children should learn better.

FF/WC1 Yeah, funding money and the ability to assess that funding in a school situation.

FF/WC2 Lots and lots of resources — lots of hands-on materials, computers. We have some wonderful maths programs on the computers, but you can see they are only very old ones. The children don't get a great opportunity, so it would probably be wonderful to have a lot more computers and lots and lots more resources, because there are a lot of resources out there, but not
enough money to spend on them. So, that would be wonderful — lots of technology to help the children, because that's the way we are going

FP/SP2 We feel the pressure to get the textbook completed by the end of the year, so we have to allocate enough time for that

FP/SP2 Although in my early years of teaching I tried to integrate maths to a fair level, now I don't, and especially at this school, where it's stated that we will use textbooks. This is not a teacher decision, from my understanding, and then it is very difficult

FT/SI1 Well, maths games — they are expensive to buy, but some of them are simple to make and the concept behind is just so simple that the school doesn't need to go on spending thousands of dollars on those games. Maths teachers can actually make them or if they have teacher aids, they can instruct them to make them, laminate them and have them for the year after and the year after but we are not imaginative enough to create them and we haven't the time to create them

FT/WP1 Because you are not going to help all the kids that need the help, and it's not enough hours in the day-time in your classroom to help the kids that you'd love to spend an hour with just helping out and talking to. You don't have that time — time is always a factor

I/SI1 I haven't been teaching for a long time, but I guess we are changing the way we do things all the time. I guess if we stagnated, we wouldn't be where we are

I/WP1 So I find I change all the time as I'm getting to be a better teacher. My view changes of how to teach things and how to do things and there's something you've got to teach. As you get more experience your views change.
Like maths teachers we change our view in line with current developments, especially in technology. Obviously, there are a lot of aspects in teaching maths that are coming forward in modern society and we have to continually update and look into new and better methods of teaching maths.

The school is very open to new ideas. I have met a lot of teachers and have been able to talk to them and find out what they are doing in different subject areas and when I have talked to the teachers at this school about new information and ideas, they are always ready to listen and think whether or not they want to implement them into their classrooms.

I try to expose them to people who are good at teaching maths so I encourage them to go to inservices and to courses. I encourage them to visit other schools who have these great mathematics programs in operation and encourage them to have a go. Change sometimes happens slowly but I try to be flexible and I try to be a facilitator and an encouraging person and I find that's a good way. It works for me.

We are very lucky here because lots and lots of ideas are put forward and the principal is very, very fair and she tries to provide as much as possible, as far as resources and things like that.

We usually go to the Catholic Education Office (CEO). Occasionally, if we have our staff meetings on Monday afternoon, if we are lucky, someone from the CEO will come out and will inservice us here. We were to have a really big inservice at the beginning of the year. Even if not the whole staffs are given the opportunity, perhaps one of the executives will go to one of the meetings and then they will come back and they will share with...
all the staff exactly what has gone on. If there are any new developments, yes, which is great, so we know exactly what’s going on.

IC/WC2 The teachers here are wonderful and everybody’s always willing to help and some will always be happy to say, Look, I’ve got something in my classroom that works, you try it and they are willing to share their ideas.

IC/WP1 If I see another teacher using a method that I like, I steal that idea.

IC/WP1 Great staff, good reputation, supportive staff, good school in behaviour and attitudes staff meetings go for an hour go for a long time and you’re welcome to give ideas and if they like your idea, they will always take it. When I was a casual and when I told something they are like, Oh, we’ll use that! This is great and willing to listen and if they think it’s a good idea, they will vote on it.

IE/WC2 So no, it was very horrendous!

IE/WC2 No, I never enjoyed maths in primary school. I can remember sitting in rows, not having anything explained to me, the brighter children who discovered easily you were fine. If you were a little slower, you were punished for asking again.

IEP/SP1 the kids always cringe when we do text work.

IEP/WP1 They enjoy working with things and going outside and measuring things or weighing things — they like hands-on mathematics but, I like to go to introduction, go through it, do some challenges, extra sheets for challenging students, test to see if they review the concept. If there’s anything I can use to stimulate them, I will use it. I used to like using chalkboard but the kids don’t like that. More excited about sitting in groups and doing activities. Nowadays have more fun with it and enjoy it.
IES/SP3  I think I had strong beliefs in rote learning. Learn the facts, learn what we can do with numbers, learn the formula and then you can apply that to situations. But for some children, that will never happen unless they figure it out from the beginning, because of their conceptual knowledge, then they are never going to get it. They can't learn from a formula and then apply it because they don't know when or how to apply it, so they must learn from the beginning how these concepts work.

IES/SP3  When the children are not successful in learning through chalk and talk then you know that you have to revert to concrete materials so that the children can actually experience what is happening, rather than relying on being told that this is a fact.

IES/WC3  Definitely, it's through my own experience. When I first started my teaching the use of concrete materials wasn't as dominant as it is now and also specially teaching the younger children, Year 1 and Year 2. Earlier in my career I found that concrete material was definitely the way to go for the children who had difficulties and that comes through too to the older children at the moment.

IES/WC3  I guess it's pretty much through success. If I can see something has worked, I'll take it on board and I'll keep working at it and keep trying to improve that method whereas if something doesn't work it confuses the children which sometimes it does specially at this age. You know, I pretty much put it at the back of the cupboard and forget about it. It's pretty much in maths if you succeed, try, and try again. If it doesn't succeed, well may be forget about that one.

IES/WP3 I find that if the children are achieving the outcomes that I have established for them, well obviously those ways are going to suit my teaching and their way
of learning that when you pick up these experiences, or pick up what is working with things that are working for you, definitely you will use those choices.

IF/SP2 I generally go to my Mum to get advice, because I feel she has a lot of experience in many different aspects of mathematics, not just because of her profession being a lecturer, but also because of her experience as a teacher and I guess, although with other subjects I would tend to ask the people here, with maths, I don't. I ask my Mum because I feel that she got the best knowledge.

II/SP2 In my early years of teaching, especially the first three or four years, I attended a lot of training courses and inservices and they led me to choose these different ways.

II/WP2 Inservicing over the years and just trying it and doing it and enjoying it. I didn't enjoy mathematics that much when I was at school but I enjoy teaching it. It's my favourite subject now.

II/WP2 When I first went teaching out in the country, the old principal would come in and say, Right, here's the drill. Tables every morning, drill these, drill these, do thousands of mentals everyday. Mostly pushing for multiplication and basic operations. That was a big push. Now, mathematics has broadened right out a lot more space and measurement activities, which is more practical. They're receiving just as much emphasis as the other number area, which makes it more interesting.

IP/SP2 I didn't enjoy it in Primary. I didn't enjoy it in High School. Then I started to enjoy at Uni, because suddenly I discovered that there was a whole new work of concrete materials.
I think that is a fault. We fall into the trap of doing things all the time and reflecting very little. One of the reasons probably is that there is so much to get through, as far as the curriculum goes, and there is little time for reflection.

I have a diary in which I write things about the students, about my teaching. I guess the reflection goes both ways — about how my students are learning and how I'm teaching. I think it's got to be a bit of both, but I don't think I do enough of it and we often fall into the trap of doing too much and reflecting too little.

I have a daybook and I write out every single thing I do each day. I comment on what worked within the class. I comment on perhaps what could be improved upon and also how the children are going. You know, whether they are enjoying things, whether they are having difficulties in grasping concepts, so that's everyday and at the end of the week, I do an assessment of just how the week has gone within the class. I have that for each day of the term.

I suppose it's better I keep a daybook but I think I just do it in my head most of the time, just think about things and see other people that's good because it makes you think about your own processes. In the past I've had a lot of supervision over the years, that sort of things died away these days it helps you reflect as well. But the older you get, you tend to look more after yourself. You tend to reflect on yourself all the time, as it's better.

When we finish, we have reflection time, good to correct your work in mathematics, see where you went. We sit back and ask how we went and how we are doing. Do you understand the concept that you learn? Some students are frustrated and that's an important reflection because it shows
they are having a difficult time. To understand those problems and how we can best remedy the problems they are having. I think reflection time is important.

IR/WP3 And after years and years of teaching, you are continually reflecting, always looking for different ways of getting the concept across. If it doesn’t work one way, you go back and think of another strategy.

IS/SI1 Yes, I did. I liked maths and I had a teacher who has used quite a bit of concrete materials, so I enjoyed maths in primary.

IS/WC2 I suppose from my own childhood experience with not ever understanding mathematics, and the teachers, the teachers who were too busy to really explain may be they didn’t understand themselves and may be they only knew the direct process of it. I suppose they need to be given lots and lots of experience and practice for themselves to discover, because of my dreadful experiences.

IS/WP1 A little bit of repeating is good, that’s from my own personal use because I wasn’t taught that way, which would have helped me out.

MFL/S32 I think it’s important because maths is everywhere. We use maths in everything we do. I think certain things we do in life need mathematics skills and I think it’s pretty important that way that we learn life skills from mathematics.

MFL/SP3 I believe it’s in everyday life, everything we do, revolve around mathematics. When we go shopping we need maths. When we calculate distances when we are traveling, we need maths. There aren’t many things we do where we don’t need maths. Every bill we pay, we need to be able to calculate whether we are being ripped off or whether it’s actual.
MFL/WP2 mathematics is now not just all sums not just learning a process but learning how to use it

MFL/WP3 For everyone in this society, you need to have a grasp of reasonable amount of mathematics skills to survive in the community not only to survive but also to figure in the community your own funds, your own lifestyle. As you become an adult, it's important. Even school kids should know and must know mathematics for their own good and it's important in our society.

MFO/S41 They are going to need it outside school, in their work. They need it for everything even going shopping, yeah, basically.

MFO/SP2 Mathematics should be taught so that ultimately people can function effectively in society. This means that not only can they function in various occupations and professions, but also in everyday life. Maths exist all around us and everywhere we turn, whether to do with driving to work or whether it's to do with shopping or even hobbies — everything has to do with maths, ultimately.

MFO/WP1 Nowadays with computer technology, you just need maths, because if you can't add or subtract, multiply or divide, even the basic maths, if you can't do that, generally you won't be able to get a good job. You need more maths just to keep up with technology.

MP/S23 I believe it gives problem solving abilities, so they can put it in contexts if they can solve the problem in maths so then they can solve the problems in other things and also that context of maths in the world.

MP/S11 We use mathematics in so many things we do — not just shopping — many other things. We think a lot in numbers. We think in terms of problem solving, so it's a very essential part of life.
MP/S13 I think maths enters into a lot of things in everyday life. I think it’s interesting to be able to discover why things work and be involved in a lot of those processes. I think also that to be able to think mathematically is a special style of thinking. Perhaps, there’s a lot more problem solving.

MU/S11 I think it’s sort of why things should, why things work out and sort of like working out numbers — number is pretty an important thing in our society — so it’s a kind of just a basic skills that everyone should need to be taught.

MU/WC1 I believe that maths should be taught in the sense that it gives an understanding of how things work in our world.

PE/S22 I just want to be a better maths teacher because maths is not one of my strongest points. So, I think it’s important for me to do a maths elective.

PE/S23 I would like to be able to teach maths properly. I think it’s a really important subject.

PE/S31 I have chosen it because to just gain ideas of teaching strategies because I believed I wasn’t thorough enough, I didn’t have a bigger understanding of how to teach mathematics in the classroom.

PE/S32 Probably just to get more experience. I have chosen science before So, probably trying to get more experience being more confident at teaching maths in the classroom just want to be more confident, more able something like that.