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**Fiji and New Zealand Pasifika students' perceptions of
mathematics and their attitudes towards
mathematics learning**

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

Master in Education

by

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Abstract

This thesis explores the perceptions and attitudes towards mathematics learning of 36 students from Fiji and 12 Pasifika students living in New Zealand. The students were in Years 7 and 8, included a range of abilities in maths as assessed by their teachers. The New Zealand (NZ) students attended a school that had participated in the Numeracy Development Project (NDP) several years prior to the study. Data was collected using semi-structured and clinical interviews. Seven key questions were the main focus of this study. The students were asked about their views on: working collectively or individually, the importance of knowing and sharing solution strategies with others, the nature of mathematics, people who supported their maths learning, their attitudes towards mathematics, and how good they thought they were at maths. They solved problems involving subtraction, division and proportional problems.

The findings revealed that nearly all of the Fiji students but just over half of the NZ students supported group work. On their views about the value of knowing others' strategies, nearly seven tenths of the Fiji students and just under a half of the NZ students thought that it was important. However, all the children were unanimous in their view that explaining their solution strategies to others was important. The findings also revealed that nearly all the students from both countries thought that mathematics was about numbers and operations. Most of the Fiji children commented that it was also about problem solving, whereas the NZ students mentioned having alternative strategies as what they thought mathematics all about.

The students' views about a teacher's role in helping them learn mathematics greatly differed between the two countries. Slightly more than half of the Fiji students thought that the teacher's role was to show them strategies. The Fiji students also described their teachers as someone who gave them notes to copy and provided exercises from the textbook. In contrast the NZ students mentioned their teacher as someone who helped their mathematics learning by sharing clues, giving tasks that challenged them and grouped them by ability before helping them. The responses of all the students revealed that there was great support from friends, parents and relatives towards their mathematics learning. The students also rated their feelings towards mathematics on a three-point rating scale with happy, neutral and sad faces.

Half of the students from both countries chose the happy face with the other half choosing the neutral face. None of them chose the sad face as matching how they felt about maths most of the time.

The students also assessed themselves on how good they were at maths. The majority of the students from both countries rated themselves as “good” and none of them chose the box showing “very poor”. The students were asked to do some tasks on subtraction, division and proportional problems. There was a major contrast between the two countries on how they worked out their answers. The Fiji students’ responses showed their fluency with standard written algorithms and a high level of procedural knowledge. The NZ students on the other hand hardly used algorithms. Instead their responses showed the use of mental strategies for solving tasks ranging from stage 2, (counting from one on materials) to stage 7, (advanced multiplicative part-whole) on the NDP Number Framework.

Dedication

This thesis is dedicated to my loving dad Cirivakavuso

and

my late mum Valeria

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CHAPTER ONE: Introduction

1.1 Background

Education is well developed and well established in Fiji and mathematics is an important subject present in the curriculum. It is one of two core subjects that are compulsory for all students to learn from Year 1 to Year 13. Generally, some students may have a hard time and struggle in their mathematics learning but just had to carry on for the sake of it. However, mathematics is very important not only for success in school, but to be a knowledgeable citizen and to be useful in one's chosen career, and in personal fulfillment. With rapid growth of globalization, greater demands have been placed on individuals to interpret and use mathematics to make sense of information and complex situations. According to Coxon (2000), primary students of Fiji today must develop the numeracy skills that they will need in order to meet tomorrow's world. In the New Zealand context, to be numerate is 'to have the ability and inclination to use mathematics effectively at home, at work and in the community' (NZ Ministry of Education, 2001).

In Fiji, numeracy is interwoven in the mathematics curriculum and emerges out of mathematics teaching. According to Hogan (2000), in order to be numerate, a person needs a combination of mathematical (understanding mathematical ideas in number, space, chance & data), contextual (ability to link mathematics to life experiences) and strategic (ability to identify and use the appropriate knowledge of mathematics in solving a problem and interpreting the outcome) knowledge. Zevenbergen, Dole and Wright (2004) suggested that, in order to be a competent and effective citizen, students need to leave school with the dispositions and competencies in mathematics/numeracy that will allow them to participate fully in the activities they undertake. Fiji through the Pacific Regional Initiatives for the Delivery of basic Education (PRIDE) project is presently undergoing educational reform and numeracy is embedded in the mathematics curriculum.

1.2 The context for the study

The report of the Fiji Islands Education Commission (2000) stated that many submissions that were made, discussed the need for the education system to promote critical thinking in order to develop high order thinking skills. One of the key features of the Classes 7 and 8 Fiji mathematics prescriptions is that the mathematics course is to provide opportunities for students to develop a broad range of skills and encourage them to be creative and good problem solvers in their daily lives (Fiji Ministry of Education, 1997). According to Coxon (2000), mathematics in Fiji should be taught and learned within a context that enhances children's problem solving skills. However, that is easier said than done as teaching is controlled by the presence of the Fiji Intermediate Examination (FIE) in June of Year 6 and the Fiji Eighth Year Examination (FEYE) in August of Year 8. Singh (1997), in his ethnographic study of curriculum implementation in two rural schools in Fiji, explained that the two external examinations (ie. FIE and FEYE), not only dictate teaching in the two examination classes, but their influence was also felt strongly in Year 5 and Year 7. For teachers, coverage of the curriculum detail is important, rather than using methods of enquiry and problem solving to develop conceptual understanding (Coxon, 2000).

The Fiji teachers, according to Coxon (2000) understand the pressure dictated to them by the examinations that made it difficult for them to develop a more creative and interactive teaching and learning environment. Unlike Australia and New Zealand, Fiji relies heavily on funding to reform its mathematics curriculum and organize in-service training courses to upgrade teacher skills. The Basic Education Management and Teacher Upgrading Project (BEMTUP) was an Australian government funded programme aimed at improving the skills and resources of primary school teachers in Fiji working at Year 7 and Year 8 level (Fiji Ministry of Education, 2000). The project consisted of a training programme for primary school teachers that would improve the content and procedural knowledge of teachers and bring about a more child-centred approach. For Fiji teachers, it seemed prestigious to teach Year 7 and Year 8 but pressure also. These teachers performance are always under the spotlight and their success is often determined by the students pass rate in the Fiji Eighth Year

Examination (FEYE). The quality of teaching in a school is often debated when there is a low pass rate.

New Zealand focussed on numeracy at national level with the Numeracy Development Project (NDP) and the focus of the project is ‘improving student performance in mathematics through improving the professional capability of teachers’. *Te Poutama Tau* is the project arm that is particularly focussed to strengthening numeracy in Maori medium schools (see <http://www.nzmaths.co.nz/numeracy/project>). NDP began in 2001 and researchers have described the NDP as having a dynamic approach which includes the development of a research-based framework that describes progressions in mathematics learning, individual task-based interviews to assess children’s mathematical thinking, and ongoing professional development to improve teacher capability (Bobis, Clark, Thomas, Wright, Young-Loveridge & Gould, 2005; Young-Loveridge, 2005).

The Number Framework consists of two main sections, strategy and knowledge, which are interdependent on each other (NZ Ministry of Education, 2007). The first five stages (0-4) of the strategy stage show the increased sophistication of the counting strategies. Stages 5-8 require students to use part-whole strategies. The students at these stages recognize that numbers are abstract units that can be treated simultaneously as wholes or can be partitioned and recombined. As Young-Loveridge (2001) explained that, strategies at stages 5-8 are based on the knowledge of using number properties to break numbers apart (partitioning) and recombine them in ways that make the problem easier to solve without counting. Young-Loveridge (2005) also emphasized that the transition from stage four to five is very important to students as they stop counting and start using part-whole strategies for addition and subtraction problems. Irwin and Britt (2005) explained that the NDP encourages students to adopt a variety of mental strategies to solve arithmetic problems such as compensation, factorization, and maintaining equivalence which were traditionally first learnt in algebra.

1.3 Researcher Positioning

I came to New Zealand to enhance my knowledge of the teaching and learning of mathematics. I had always taught in an expository manner and had always directed the

students about how to do things. In semester 1 2006, I was enrolled in “*MSTE502 – Acquiring Numeracy: How children’s thinking develops*” a course which explores what it means to acquire numeracy, and examines the ways that children’s strategies become increasingly sophisticated as their mathematical thinking develops. The focus is on conceptual understanding and the kinds of strategies children use to solve mathematical problems in classrooms and in everyday life. It greatly shifted my view of teaching mathematics. I wanted to learn more about how children acquire numeracy and the NDP. I was curious to know more about what children think about mathematics learning.

I had been teaching mostly in the intermediate level in Fiji for the past seventeen years and it had never occurred to me that simple comments from students about liking or hating mathematics had a great impact on their performance. I have seen students struggle to understand mathematical concepts, students who fail in mathematics tests and students with parents who have high expectations of them that they will pass in the external exams. I have devoted a lot of time to helping students to develop their confidence and motivate them to succeed as I always wanted my students to learn to their maximum potential. I did not realize until recently that unpleasant and negative experiences affect students’ attitudes and feelings towards mathematics.

Much had been said about low achievement of Pacific Island students in mathematics compared to other ethnic groups. That is why I was interested in exploring Fiji and NZ Pasifika student’s perspectives on their mathematics learning, especially in a culture where adults do not listen to pupils’ views. I think that it is important to find out their perceptions of mathematics and their attitudes towards mathematics learning because it could have a direct impact on their performance. I am also interested in the effect of national examinations in Fiji on their mathematics learning. I also consider that it is important to gain insights into the reasons why children develop their beliefs and attitudes towards mathematics and the impact of these on their learning.

1.4 Research question

What are the perceptions and attitudes of Fiji and NZ Pasifika students towards their mathematics learning?

1.5 Overview of the Thesis

This chapter gives an introduction to the thesis and states the research question. Chapter two presents a review of relevant literature on children's mathematics learning. The main focus is on the contrasting education systems of the two countries and the seven key issues that were the basis of this research work. This includes group work, communication, the nature of mathematics, people who supported mathematics learning, attitudes towards mathematics, self assessment, and problem solving. Chapter three details the research question and the methodology used. The results are presented in Chapter four in which a systematic analysis was made of all transcripts and presented in tables. Selected excerpts from the transcripts are also presented to throw light on students' own views and help to illustrate the quantitative analysis. Chapter five discusses the results and makes links to the literature review outlined in the second chapter. Limitations of the study, implication and recommendations for further research are discussed in Chapter six.

CHAPTER TWO: Literature Review

2.1 Background

Listening to pupils talking about their learning gives teachers the potential to see how they practice from a different angle and also awareness on how pupils think. Recently, some studies have drawn attention to the importance of talking and listening to students in order to appreciate their unique perspectives (Flutter & Rudduck, 2004; Hawera, Taylor, Sharma, & Young-Loveridge, 2006; Rudduck & Flutter, 2000; J Young-Loveridge, 2005; Young-Loveridge & Taylor, 2005; Young-Loveridge, Taylor, Hawera, & Sharma, 2006). The inclusion of pupils voice in decisions about aspects of school life has been an issue over the past decade and the United Nations Convention on the Rights of the Child has legitimised this policy (Whitehead & Clough, 2004). Rudduck and Flutter (2000) stressed that we have to take a moment to look at the progress of the children's rights movement if we are to understand attitudes to pupil participation and pupil voice. They explained that children's rights have mainly, but not exclusively, been argued for by adults on behalf of pupils, whereas 'pupil participation and perspective' suggests a stronger input by pupils themselves and a readiness among adults to hear and to take seriously what they have to say (p76). Article 12 of the United Nations Convention on the Rights of the Child (UNCRC) reads as follows:

‘States Parties shall assure to the child who is capable of forming his or her views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child’.

Given the above, children have a right to participate and to be consulted. Researchers have been emphasizing that children are major stakeholders in the process of learning in our schools, so it is important to listen to their understandings about their experiences (Rudduck & Flutter, 2000; Whitehead & Clough, 2004; Young-Loveridge, 2005). It is generally accepted that pupils do not have much to say about the curriculum, but they have much to say about “the conditions of learning in schools; how regimes and

relationships shape their sense of status as individual learners and as members of the community and, consequently, affect their commitment to learning in school” (Rudduck & Flutter, 2000 p.76). Children have a right to be heard especially on issues that affect them directly in their classrooms. This will give them a stronger senses of ownership and engagement with learning, and for teachers a deeper insight on their potentials and the how they want to learn.

Cook-Sather (2002) pointed out that pupils should be given the opportunity to reflect on experiences in school so that they will have a deeper insight about how they learn and prepare themselves to take an active part in their education because they are involved. According to Rudduck and Flutter (2000), pupils’ explanations of their experiences of being a learner in school can lead to changes that enable pupils to feel a stronger sense of obligation to the school and to the task of learning, and also lead them to work hard and raise their levels of attainment (Rudduck & Flutter, 2000). Whitehead and Clough (2004) describes interviews with 139 Year 8 pupils in two inner-city zone schools in England to gain an insight into their perceptions about their learning and reported that if inner-city zone schools are to live up to their promise of empowering communities and schools then pupils needed to be consulted and to be included in policy making. They concluded by suggesting that this will require a shift in our thinking to recognize pupils as co-constructors of learning, work with them and encourage pupil participation and enable their voices to be heard.

There has been a limited amount of research in the Pacific, New Zealand, and also internationally that probes students’ perceptions and views of their learning of mathematics. According to Young-Loveridge, Taylor, Sharma and Hawera (2006), children had been spending a lot of time doing mathematics but little is known about their views on the mathematics that they do. Grootenboer (2002) and Young-Loveridge (2002) in their study reported that, from a very young age children know that mathematics is important. Howard and Perry (2005) interviewed Aboriginal children in a remote rural community in New South Wales to explore their beliefs about learning mathematics. The responses of the children seemed to reflect an external conception of mathematics, with the children positioning themselves as passive recipients of the teacher’s wisdom and superior knowledge. According to Howard and Perry, these

children did not seem to be aware of their own mathematical competencies, strategies, and problem solving abilities in mathematics. Instead they emphasized the importance of watching and listening to the teacher. These findings suggest that it is important to listen to students' views, so that teachers can gain deeper insights into children's abilities and learning preferences that will lead to improvement in the teaching and learning of mathematics.

2.2 International reforms in mathematics

Major international reports on mathematics teaching and learning emerged during the 1980s such as *An Agenda for Action* (1980) published by the National Council of Teachers of Mathematics (NCTM) in the United States and *Mathematics Counts* (1982), published by the British Department of Education and Science promoted a different direction in mathematics education. The reports gave more prominence to problem solving and an investigative approach to mathematics teaching with increased interaction between students and teachers. Of paramount importance too, was the relevance of mathematics to everyday life to ensure that mathematics would make sense to students. The expectations were that teachers would use a wider variety of strategies as a result of a more professional approach to education. This had created a shift from the traditional focus and children are released from memorization of rules and repetition to alternative methods. NCTM however, recommends moving away from the traditional focus on listening to the teacher for acquisition of facts, memorization of isolated information, computational skills, drill and practice and textbook based instruction (McClintock, O'Brien, & Jiang, 2005).

2.3 Reform in mathematics education: Literacy and Numeracy Strategy (NZ)

The Literacy and Numeracy strategy, within which the Numeracy Development Project (NDP) sits, is a major initiative in mathematics designed to improve the achievement in numeracy of students at every level of the education system. The NDP is guided by several key themes, the first of which is "raising expectations for students' progress and achievement" (Ministry of Education, 2002). In addition the NDP has several key features, including the number framework which consists of a sequence of stages,

showing the progression of children's thinking and use of mental strategies to solve increasingly complex mathematics problems (Ministry of Education, 2007a, 2007b). The framework has two independent aspects: Strategy and Knowledge. Strategies help to create new knowledge through use, while knowledge provides the foundation for strategies. It is important that students make progress in both sections of the framework. Strong knowledge is essential for students to broaden their strategies across a full range of numbers, and knowledge is often an essential prerequisite for the development of more advanced strategies (Ministry of Education, 2007a).

The strategy section of the framework consists of a sequence of global stages (Ministry of Education, 2006a). Each strategy stage includes the operational domain of addition and subtraction, multiplication and division, and proportions and ratios. The initial stages on the framework are characterized by the use of increasingly sophisticated counting strategies. Progress through the stages indicates an expansion in knowledge and in the range of strategies that students have available. The transition between stage four and stage five is thought to be particularly important, as children let go of counting as a solution strategy, and begin using knowledge of part-whole relationships (Young-Loveridge, 2002). For example, at Stage 5: Early Additive Part-Whole students can recognize that numbers are abstract units that can be treated simultaneously as wholes or can be partitioned and recombined. Thus $10 + 4 = 14$ so $9 + 4 = 13$. Advanced Additive Part-Whole students (Stage 6) are learning to choose appropriately from a repertoire of part-whole strategies to solve and estimate the answers to multi-digit addition and subtraction problems. For example: $53-26$ as $53 - 30 + 4$ (standard place value with tidy numbers and compensation).

According to Umaki & Young-Loveridge (2004), the NDP puts a strong emphasis on developing students' mental strategies and there is an absolute rejection of algorithms. They further explained that mental strategies can be used to simplify calculations but students should have a good understanding of number properties and the relationship between numbers and operations. Lessons in the NDP classrooms are structured with a key emphasis on strategies and according to Higgins (2001), the NDP had illustrated a shift in teachers' emphasis on the teaching of knowledge to that of strategies as a critical factor. McIntosh (2005) emphasized that mental computation promotes number sense

through a development of understanding how numbers work and relate to each other. Students should not be exposed to standard written algorithms until they are able to use part-whole mental strategies. Evidence has shown that the teaching of standard algorithms before a child is ready can be detrimental to their conceptual development (Baroody & Ginsburg, 1990), and delaying the introduction of written algorithms is beneficial to students (McIntosh, 2005).

2.4 Education system in Fiji

Almost all of the schools in Fiji have a structure of eight primary years (Classes 1-8/Year 1-8) followed by four years of secondary school (Forms 3-6/Year 9-12) and then Form 7 (Year 13). Children at the age of six are enrolled in Class 1, and most of them are 18 years old when they reach Form 7. In most schools, the first three years are taught in different languages (i.e., Fijian, Hindi, Chinese, Rotuman or English). English becomes the language of instruction from Class 4 onwards. The Ministry of Education is responsible for the administration and management of education policy, curriculum development, exam provision, and training of qualified teaching personnel that support schools in the delivery of quality education for students (Ministry of Education, 2005; Tavola, 2000).

The community plays a vital role in the development of education in Fiji (Ministry of Education, 2005) and the partnership between the state and the wider community is one of the distinctive features of education in Fiji (Tavola, 2000). There is no zoning of education in Fiji and parents send their children to any school of their choice, for example a school which in their view has been producing favorable results in terms of pass rates. It is not uncommon to see children travelling from their villages or rural settlements to the urban centre everyday or being sent to boarding schools miles away. The majority of the schools are owned and managed by committees and religious organizations with only a few state-owned secondary schools.

Education in Fiji is centralized and the Curriculum Development Unit (CDU) plays a major role in developing and revising curricula. The main function of a curriculum project is the creation of new materials, mainly in the forms of teachers' guides and pupils' workbooks (Sharma, 2000). Curricula are overcrowded with factual content

(Coxon, 2000) and have remained largely examination-driven and prescriptive in nature (Sharma, 2000). In such an environment, teachers “work to the reality imposed by assessment rather than to the rhetoric of a statement of intent” (p. 165). With limited resources in most Pacific Island countries including Fiji, curriculum projects are aid dependent or donor driven as Fiji relies heavily on New Zealand, Australia or Europe for funding. The existence of aid-funded personnel in key positions of curriculum development units contributes to internalising of western type models of education but also these expatriates culture, values and preferences have a significant impact on outcome of the curriculum (Luteru & Teasdale, 1993). It is not uncommon and it has been experienced by most Pacific Island countries that the donor countries influence will be clearly evident in the outcomes of what had been developed.

Fiji has an academic system driven by examinations and all of the external examinations are localized (see: <http://www.education.gov.fj>). During the sixth year of schooling (Year 6) the students attempt the Fiji Intermediate Examination in July. The Fiji Eighth Year Examination (August, Year 8) is compulsory for all students as it determines their entry into a secondary school of their choice for Form 3 (Year 9). Then in Form 4 (Year 10) they sit the Fiji Junior Certificate Examination which is also compulsory for it determines their entry into Form 5 (Year 11). The Fiji School Leaving Certificate (Year 12) is also compulsory for all Form 6 as it also determines their entry into Form 7 (Year 12) or into any tertiary institution. The Fiji Seventh Form Examination (Year 13) is taken at the Form 7 level as selection into tertiary and university education is also based on it. According to Tavola (2000), the existence of two external examinations at primary level and three external examinations at the secondary level determines how teachers teach and that teachers put more emphasis on the examinable subjects rather than the non-examinable areas which they regarded as unimportant.

2.5 Education system in New Zealand (NZ)

In contrast, NZ education has moved from a quite centralized structure to one in which individual schools and tertiary institutions have considerable responsibility for their own governance and management, working within the framework of guidelines, requirements and funding arrangements set by central government and administered through its

agencies (see: <http://www.minedu.govt.nz>). Schooling is available to children from age five and is compulsory from age six to sixteen. The primary education from Year 1 until Year 6 is offered at primary level. Students at Years 7-8 can attend a full primary or intermediate school. Secondary education covers year 9 – 13 (aged 13-17) and most schools are English medium with a few teaching in the Maori medium. Assessment of individual students' progress is essentially diagnostic in a school that adopts NDP and school-based assessment method cover a range of formal and informal procedures (Ministry of Education, 1993).

Baker (2001) pointed out that the 1990s was a time of remarkable change in New Zealand schools. The decentralization of the administration of schools was intended to “result in more immediate delivery of resources to schools, more parental and community involvement and greater teacher responsibility. It was intended to lead to improved learning opportunities for the children of this country” (Department of Education, 1998: p. iv). The administrative reforms were accompanied by significant policy developments in curriculum and assessment. The Education Act (1989) laid the foundation for a national curriculum: *The New Zealand Curriculum Framework: Te Anga Matauranga o Aotearoa*, was published by the Ministry of Education in 1993. The framework sets out the overall policy direction for the school curriculum. It includes the principles which underpin the curriculum and describes seven essential learning areas, eight sets of essential skills and the commonly held attitudes and values which should be developed and reinforced through the school based curriculum. National curriculum statements that detail what students are expected to learn in years 1-13 were progressively introduced the 1990s.

The *New Zealand Curriculum Framework (NZCF)* was the first comprehensive national statement on the curriculum in New Zealand. It is the official policy for teaching, learning and assessment in state schools and state integrated schools. It provides direction to: all schools, including kura kaupapa Maori (Maori medium) and special education schools (although not private schools, even though, in fact, many do use it); all students, irrespective of gender, ethnicity, belief, ability or disability, social or cultural background, or geographical location; all years of schooling, from new entrants to the completion of schooling.

NZ population is becoming more diverse and with rapid growth of technology and demands from the workforce, saw the publication of a new curriculum document (Ministry of Education, 2007). The New Zealand Curriculum (2007) states in its vision that it wants young people to be confident, connected, actively involved and lifelong learners. It listed a set of principles on which to lay the foundation of curriculum decision making. It sets out values that are expressed through the ways in which people think and act. It defines five key competencies that included thinking, using language, symbols and texts, managing self, relating to others, and participating and contributing. These key competencies are the key to each students search of lifelong learning and to their contribution to a well-functioning society. Like all curriculum documents the framework is value laden.

Also during the 1990s New Zealand settled into a system of self-managed schools governed by elected community boards of trustees (governors). These changes coincided with national economic change from a welfare state to a neo-liberal market economy designed to enhance New Zealand's global trading competitiveness. The responsibility of the board involves meeting the legal requirements of the Education Act (1989)-the National Administration Guidelines. In effect this means the Board of Trustees is the employer and is ultimately responsible for managing teacher performance, the effective implementation of the curriculum, the finances and the school property (Baker, 2001). The Education Review Office (ERO) established under the Education Act (1989), has the responsibility for evaluating school-based education through reviewing and reporting on the performance of the managers and professional staff of New Zealand Schools.

2.6 Mathematics achievement of Pasifika students (NZ)

New Zealand is becoming increasingly multicultural, a trend that is likely to continue is the decline in the proportion of Pakeha, as Maori and Pasifika¹ people make up an increasing proportion of the population. It is estimated that by 2051, a third of all NZ children will be Pakeha, a third will be Maori and just over a fifth will be Pasifika

¹ The term Pasifika in this paper is used collectively to refer to people from the islands of the Pacific who have identified themselves as originating from there.

(Education Review Office (ERO), 2000). Research has shown that at every level of the education system Maori and Pacific Islands students achieve considerably at a lower level than students from other ethnic groups. According to Clark (2006), the participation and performance of Pacific students in mathematics is even worse than that of Maori given that conventional methods of assessment are used in NZ.

Results from NZ's participation in the Third International Mathematics and Science Study (TIMSS) showed that at the Year 8 and Year 9 levels, students identifying themselves as Pakeha/European or Asian outperformed, on average, those identifying as Maori or Pacific Island students (Chamberlain, 1997). Research also reported that Asian and Pakeha/European students in Year 4 achieved at a substantially higher level than students from the other two main groupings, with the difference between the highest scoring group – Asian – and the lowest scoring group – Pacific Islands – being approximately 16%. When compared with their international counterparts, NZ students' performance was well below the international means. This was an issue of concern for NZ and led to the first Numeracy Development Project (NDP) beginning approximately seven years ago aiming at improving the mathematics teaching and learning of students at the primary level and later the secondary level.

The findings on the patterns of performance and progress on the NDP (2001-2003) reported that all students benefited from participation in the NDP regardless of ethnicity, gender and socio-economic status (Young-Loveridge, 2004). Thus the relative differences between sub-groups were virtually identical at the end of the project. Asian and European/Pakeha students began the project at higher stages on the number framework than students of Maori and Pacific Islands descent, and then made slightly greater progress over the period of intervention. Hence the "achievement gap" was widened by the project, rather than narrowed. Research recommended that teachers be encouraged and supported to find ways of more effectively meeting the learning needs of Maori and Pasifika students (Young-Loveridge, 2004). In 2006, the Pasifika students particularly (and Maori students also) did better as a result of the NDP. According to Young-Loveridge (2006) this was evident in the larger effect sizes found when comparing both younger Pasifika students after a year of the NDP and slightly older Pasifika students before they had begun the NDP with corresponding European

students. She thought that the improvement might be the result of a combination of the schooling improvement initiatives like the Manurewa Enhancement Initiative, and recent home-school partnership projects with Pasifika communities.

2.7 Mathematics achievement of Fiji students

The Education Review Commission/Panel (2000) reported that overall, mathematics results in Fiji were comparable through primary and early secondary, but there was disparity in the sixth form level and this widened in the seventh form level. Primary schools in Fiji conduct mid-year and annual internal examinations at year level. Two external examinations are administered by the Ministry of Education when students are at the Year 6 (Fiji Intermediate Examinations) and at Year 8 or Form 2 (Fiji Eighth Year Examination). Children at both these grades (Year 6 & Year 8) then prepare themselves for two internal and two external examinations in one year. Five subjects (English, Mathematics, Basic Science, Social Science and Health/Environment/Values). Vernacular (Fijian, Hindi & Urdu) is optional while the other more practical and cultural subjects (Physical Education, Music, Gardening and Art & Craft) are not easily examined and regarded as not important. These external examinations results are often analyzed in terms of gender and ethnicity and reported to the public by the Ministry of Education. The Education Commission Report (Ministry of Education, 2000) expressed the view that there was not much hard evidence available to either prove or disprove the perception held by some, as expressed in submissions, that primary school standards are falling.

Fijians and Indo-Fijians², the two major races in Fiji have been involved in the same education system for more than 90 years but it had been well established that at the upper secondary levels Indo-Fijians perform better than the Fijians (Ministry of Education, 2000). Numerous studies have attempted to examine Fijians under-achievement in education, focusing on failure rather than their academic success and blaming culture and the Fijian way of life (Ministry of Education, 2000). Failure of indigenous Fijians in the educational system is described as the “Fijian education

² The people of Fiji call ethnic Fijians “Fijian” and Indians “Indo-Fijian”

problem” (White, 2001). Bakalevu (2000) investigated a Fijian perspective to mathematics and mathematics education and suggested that the difficulty that children have with mathematics is not a Fijian problem but a mathematical problem. She recommended that be taken to adopt a new approach to teaching mathematics. The 2000 Education Commission/Panel reported the results of the 1999 FIE and FEYE for Year 6 and 8 students from 27 selected schools, which revealed some interesting information regarding the relative success rates of Fijians and Indo-Fijians in mathematics (Ministry of Education, 2000). In the FIE examination, out of the 2,463 students, 92% Fijians passed mathematics as compared with 95% Indo-Fijians. Similarly in the FEYE examination, out of 2381 candidates, 82% Fijians and 89% Indo-Fijians passed mathematics. According to Coxon, 2000 the validity of this examination is questionable because the overall pass for both examinations is fixed at a high rate. If this is the case than we should not speculate as we cannot really prove the true performance of Fiji students in mathematics in Year 6 and 8.

2.8 Curriculum reforms (Fiji)

Education reforms in the Pacific, including Fiji, are aid-dependent. Changes to the education system came about in the early 1970s when a team of curriculum planners developed the Forms 1-4 (Year 7-10) curricula. The UNDP/UNESCO curriculum development project adopted a subject-based development approach and introduced a pupil-centered rather than teacher directed approaches to education (Sharma, 2000). They created new material for all subjects in the form of teachers’ guides and pupils’ workbook and distributed them to schools. This practice remained when the CDU assumed the responsibility of developing and managing curriculum for all schools in Fiji. The Education Review Commission/Panel (2000) explained that the education officers attached to the CDU review the curriculum carry out experimental trials of draft materials and also conduct workshop to familiarize the teachers of what is needed of them. According to Thaman (2001), an important lesson that was learnt from this UNESCO/UNDP project was the realisation by some curriculum personnel that the products as well as the process of curriculum development needed to be more culturally sensitive and inclusive.

Any other reform from then on was the responsibility of CDU but despite the many reforms, the school curriculum was still examination driven and prescriptive in nature (Sharma, 2000). The students tend to resort to rote learning as they are placed under pressure, due to its focus on individual achievement, use of western models of education, and the provision of lessons in English, their second language (Ministry of Education, 2000). Revision of the curriculum was done in year levels, for example Year 7 or Year 8, for the four core curriculum areas (English, Mathematics, Social Science and Health Science) for example, the BEMTUP project in 1996 sponsored by the Australian government (AUSAID) under the management of Griffith University. They reviewed the Year 7 and Year 8 curriculum and held in-service training workshops for teachers. According to Sharma (2000), the Fiji education curriculum needs reform as it is too abstract, too geared towards learned procedures and factual knowledge, and substantially divorced from real life.

The Fiji Education Sector Program (FESP), an Australian government initiative aims to improve the quality and delivery of education in Fiji began in June 2003 as a three year program but has been extended to 2008. The programme aimed to enhance the quality of education for students by providing mechanisms to improving planning, management and the provision and monitoring of educational services. In addition, the programme also aimed for sustainability of the reforms where sustainability is the continuation of benefits after major assistance has been completed (AusGUIDE, 2003). The executives of FESP suggested that Literacy and numeracy were in need of reforms. They agreed that there is a need to adapt intervention strategies already in use in Western Australian schools to assist low-performing students as it was realized that some districts in Fiji were showing poor literacy and numeracy skills (Dixon & Dixon, 2008). The Western Australian education system has many similarities with Fiji especially the challenges in providing education services to rural and very remote areas.

2.9 Ways of learning mathematics individually or collectively

A Cultural perspective

All the cultures of the South Pacific nations emphasize the group over the individual and foster cooperative methods of problem-solving rather than individual or solitary effort

(Clark, 2001). The Fijian people have a predilection for doing things together rather than individually, and by participating in group activities, they learn the value of team-work and co-operation (Ravuvu, 1983). Fijians promote communal living and work against individual aspirations for the sake of individual advancement (Nabobo, 2001). Traditional obligations are met in groups in which they share their responsibilities and help each other without questioning how much one has contributed as a sign of caring for each other. Ravuvu (1987) expressed the idea that the ethnic Fijian ideals of sharing and caring are embodied in such terms as *veivukei* (giving a helping hand), *veinanumi* (consideration for others), *veilomani* (being loving and friendly to one another) and *yalo vata* (of being the same spirit). It is generally believed that anyone who sets out to work alone easily loses heart and interest in the task but becomes immediately enthusiastic and energized when joined by the company of others (Bakalevu, 2000).

According to Bakalevu (2000), Fijians also learn orally, co-operatively and on site. Children are taught to be good listeners and to show respect by not questioning elders and being often quiet is highly regarded in the ethnic Fijian community (Nabobo, 2001). Ravuvu (1987) and Nabobo (2001) pointed out that silence is regarded as polite and children are asked to avoid conflict with their parents and teachers. This behavior makes it hard for teachers to encourage them to ask questions or discuss matters.

Collective learning

Trafton and Bloom (1990), argued that children learn through social interaction, by talking and actively engage in activities with their peers, in whole class, small groups or individual activities. Evidence have shown that students achievement in mathematics can be increased by using small groups of students to work on activities, problems and assignments (Grouws & Cebulla, 2000). Not only do students benefit academically but they also benefit socially from cooperative small group learning (Gillies, 2002). According to Steffe, Neshier, Cobb, Goldin and Greer (1996), learning is a social process that frequently occurs in the interaction of individuals where students are working cooperatively sharing ideas and completing problem solving tasks with each other. Some studies had examined the types of interactions that occur amongst students during their mathematics classes as they learn in small groups and found out that most task-related interactions seemed to be related to help they seek from or offer each other (Newman &

Goldin, 1990; Webb, 1991). Numerous studies had shown many advantages of seeking help in the classrooms when students needed help but a lot of students are reluctant to do so (Good, Slavings, Harel, & Emerson, 1987; Newman & Goldin, 1990).

In the NZ curriculum, group work is promoted both as a means and as an end. The curriculum emphasizes both the active construction of knowledge through discussion, and the process of doing mathematics in collaboration with others. The NZ Curriculum Framework (1993, 2007) and the Mathematics in the NZ Curriculum (1992) both highlight the importance of group work for promoting the learning of mathematical processes. According to Higgins (2000), the emphasis has shifted from the purely social and organizational aspects of doing an activity together, to also include the mathematical processes which focus on how to do the activity together as the curriculum now requires the teacher to teach, and assess strategies and skills for learning mathematics. *NDP Book 3: Getting Started* (MOE, 2007) recommended that the teacher should consider the students ability to work collaboratively and their personal characteristics when forming instructional groups.

Webb (1991) explained that students' experiences in small groups can influence their learning, either for better or otherwise. According to Rosenthal (1995), the practice of working together in small groups or cooperative learning can benefit students in a number of ways. He explained that when students are actively involved they are better able to learn and retain concepts, students can learn from each other and can learn by teaching each other, students can learn to share their ideas and listen to the ideas of others and students also sense a caring environment. However, passivity can also occur in small groups amongst low achievers as they seem to demonstrate a high level of passive behavior in cooperative small groups (Mulryan, 1992). Both Piaget and Vygotsky saw cooperative learning with more able peers and instructors as resulting in cognitive development and intellectual growth (Johnson, Johnson and Smith, 1998).

Evidence had shown that low achievers tend to focus more on the non-task-related aspects of work. For example, most low achievers considered that more learning and better learning or learning to work with others as the main purpose of cooperative small group instruction (Good, Mulryan, C., McCaslin, M., 1992). Furthermore, Newman and

Goldin (1990) explained that low achievers might have been reluctant to seek help because they wanted to avoid being humiliated from group members or receiving less help. The students who actively engage in the discussion by asking questions or answering questions of others are the ones who benefit most from grouping situations (Brophy & Good, 1986).

Higgins (2005) highlighted the idea that friendship and heterogeneous grouping also have powerful in learning classrooms. Other studies have shown that most teachers have a positive attitude toward ability grouping because students are working on different levels and this would enable teachers to adjust their pace, class content and teaching methods to students' who are working on different levels (Slavin, 1988, , 1990; Sorenson & Hallinan, 1986). The reasons for mathematics teachers supporting ability grouping are varied, but can be tied to a belief that sees mathematics as a hierarchical discipline where concepts build on previous concepts (Ruthven, 1987) which makes it difficult to work with heterogeneous groups. Litchevski and Kutscher (2002), in their study have shown that students of all ability levels can learn mathematics effectively in heterogeneous classes to the satisfaction of the teacher. Slavin (1990), also stressed that mixed ability teaching lessens the chances of discrimination, but evidence must be provided with those who claim that it raises achievement.

2.10 Communication in Mathematics

Current reforms in mathematics had greatly shifted the ways of teaching mathematics internationally. Communicating mathematical ideas by providing opportunities for students to express their views had been greatly encouraged. Mathematics in the New Zealand curriculum (Ministry of Education, 1992) stated that, "critical reflection may be developed by encouraging students to share ideas, to use their own words to explain their ideas and to record their thinking in a variety of ways" (p.11). The Fiji mathematics prescription (Ministry of Education, 1997) stressed that students should be encouraged to think critically to the views of others, and to think about and explain what they are doing and why, as they engage in mathematical activities. Lampert and Cobb (2003) emphasized that communication is an important aspect of participation in the activities of a mathematical community like a classroom. It is an important part of problem

solving, as students need to clarify the initial question, explain the answer in the context of the problem, and justify the method used, and reasoning also implies communication (Baldwin, 2002). The processes of communication encompasses many other learning activities, such as recording; presenting ideas and results to others; explaining, discussing and presenting arguments; and working co-operatively as part of a group (Ministry of Education, 1992).

Mathematics education reforms have called for mathematics to be a more public activity, with learners communicating openly about their solution strategies (Yackel & Cobb, 1996). Boaler (2003) mentioned that within classroom discourse communities, the teacher's role is structured to socialize students into the mathematical discourse community. However, learning to communicate effectively depends on the presence of supportive participants who can scaffold and extend the learners' language as they grapple with more challenging ideas (Young-Loveridge, 2005). Knowledge and sharing solution strategies are in the context of strategy reporting community as argued by Hunter (2005). Thomas and Ward (2002) explained that the key to effective teaching is to ask students to explain their thinking and giving them time to do so, and asking questions and using student's explanations to enhance their thinking. Hunter (2005) in her study of reforming communication in the classroom found that by the end of the year students had started using enquiry and explaining their thinking in the classroom building up to argumentative discourse.

Young-Loveridge (2005) has argued that, there should be evidence in the ways that children talk about their mathematics learning in classrooms if the NDP is to make a major difference to what happens in classrooms. She and colleagues carried out student interviews, exploring a range of issues that focused on how students felt about the importance of communicating their mathematical thinking to others and listening to the strategies of their peers. She reported that only about half of the students in their 'perspectives' study thought that explaining their strategies to others was important. The study showed that a substantial number of NDP students still believed strongly that mathematical thinking should be private. Their responses in the interviews showed that students continued to regard mathematics from an individualistic perspective as being a private activity that was of little or no concern to others in their class. Young-Loveridge

further highlighted that the findings showing that students are far from comfortable about communicating with peers about their thinking, let alone appreciating the benefits of communication for their own learning.

According to Newman (1990), students have a range of reasons for not communicating their mathematical ideas with others. For example, some of them might have been reluctant to seek help because they wanted to avoid appearing stupid, receiving negative sanctions from group members, or receiving inadequate help. To do well in mathematics students need to listen to their peers as well as their teachers, be able to explain their thinking to others and build upon their own understanding of mathematical concepts (Trafton & Bloom, 1990; Young-Loveridge, Taylor, & Hawera, 2005; Young-Loveridge, Taylor, Hawera, & Sharma, 2006)

Support for students is vital. Students who have the opportunities, encouragement and support for speaking, writing, reading and listening in mathematics classes reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically (NCTM, 2000). In addition, students do not necessarily talk about mathematics naturally; teachers need to help them learn how to do so (Yackel, Cobb, & Wood, 1993). Students whose primary language is not English may need some additional support in order to benefit from communication-rich mathematics classes, but they can participate fully if classroom activities are suitable for them (NCTM, 2000). In sum, when students make mathematical arguments, they do not simply share their answers; instead, they explain and justify the ideas that they had as they thought about and solved the problem (Whitenack & Yackel, 2002).

2.11 Nature of mathematics

Borasi (1990) stated that the views, attitudes and assumptions regarding mathematics, mathematics teaching and learning have been an important factor underlying students' school experience and achievement. Different views of mathematics have an impact on the ways in which society views mathematics (Dossey, 1992). Grootenboer (2003) and Young-Loveridge *et al* (2006) investigated the views and feelings of New Zealand children on the nature and purpose of mathematics and how they saw themselves as learners of mathematics. The children's responses indicated a rather narrow view of

mathematics, limited mostly to number and operations. Young-Loveridge *et al* (2006) further argued that children should have a view about what mathematics is and if they do not that will make it hard for them to make the most of the mathematics they are learning. Students' conceptions also shape the way they approach mathematics tasks.

Frank (1988) carried out a study by using a questionnaire, interviewing and observing 27 mathematically talented middle school students to investigate their beliefs about mathematics and how these beliefs influence their problem solving practices. She reported that students held a procedural view of mathematics and that mathematical problems must be quickly solvable with an algorithmic approach and getting the right answer was very important. For these students the role of the teacher was to transmit knowledge and the role of the students was to acquire mathematical knowledge.

According to Cobb (1987) and Garofalo (1989), if children had a view that to know mathematics was to produce correct answers with procedural fluency then they were less likely to place value on discussing and interpreting the problem with others and alternative solution strategies. Garofalo, (1989) further explained that, "the nature of the classroom environment in which mathematics is done strongly influences how students view the subject of mathematics, the way they believe mathematics should be done and what they consider appropriate responses to mathematics questions" (p.451). Different views of what it means to do mathematics were found in a study of the views of 36 first-grade children from six Cognitively Guided Instruction (CGI) classrooms (Franke & Carey, 1997). They reported that most students had a broad view of mathematics. They talked about problem solving and mentioned both word and non-word problem when asked what they would tell other students about first grade mathematics. They also mentioned about using equipment, alternative strategies and explaining and sharing their solution strategies to others.

One of the aims of the of the Fiji Class 7 and 8 mathematics is to "develop the pupils ability to connect mathematics to everyday situations" (Fiji Ministry of Education, 1997, p.2). The NZ mathematics curriculum document also emphasized that "mathematics education aims to develop in students the skills, concepts, understandings, and attitudes which will enable them to cope confidently with mathematics of everyday life" (NZ

Ministry of Education, 1992). Connecting school mathematics and everyday mathematics could either be helped or hindered by beliefs about the nature of mathematics (Presmeg, 2002). Young-Loveridge, Taylor, Hawera and Sharma (2006) in their study reported that a large number of students that they interviewed talked about the usefulness of mathematics and how useful mathematics is for their futures. Researchers like Holton (1993) reports about the pleasure people get from exploring mathematics. Young-Loveridge, Taylor and Hawera (2005) also reported that only the younger students described mathematics as an enjoyable pursuit and that there seems to be an age-related decline in students' enjoyment of mathematics.

2.12 People who support mathematics learning

The role of teachers

International reforms in mathematics education had been stressing to children to view learning as a social activity in which they interact and share their ideas with each other, their teachers and the wider community (Lampert & Cobb, 2003). Primary school teachers' of mathematics role in supporting children's learning of mathematics should not be underestimated. Evidence had shown that children began to form their views about the role of their teachers and how they help in their learning once they start school (Daniels & Perry, 2003; Diaz-Obano, Plasencia-Cruz, & Solandro-Alvarado, 2003). Taylor, Hawera and Young-Loveridge (2005) in their study reported that children had strong views about their teacher's role, that they should help them with strategies for learning when they were experiencing difficulty, and working with others. According to Williams and Baxter (1996) students are expected to contribute actively to the understanding in the classroom because the teacher is no longer the only source of knowledge. Diaz-Obano *et al* (2003) explained that some students have a view that mathematical concepts must be explained to them by their teachers. Some students believe that a safe classroom environment is one in which teachers and well as fellow students care about them (Baker, 1998).

Demetriou, Goalen and Rudduck (2000), in their exploratory study explained that as year 7 and 8 students became familiar with a wide range of teachers they had encountered, they could describe who they thought was a good teacher. The students said that they

thought a good teacher was someone who consulted them, who was fair, who made them feel important and who treated them in an adult way. There are also children who view their teachers' role in mathematics learning as that of a manager, mentor, transmitter of knowledge and decision maker (Taylor, Hawera, & Young-Loveridge, 2005). Aubrey (1997) argued that understanding the subject content to be taught is a vital requirement of teaching as the aim of teaching was to help others to learn.

Teachers' classroom practices are influenced by the nature of teachers' beliefs about mathematics and about its teaching and learning (A. G. Thompson, 1992). Fennema and Franke (1992) stated "no one questions the idea that what a teacher knows is one of the most important influences on what is done in classrooms and ultimately on what students learn" (p.147). According to Perry et al (2002), researchers over the past years had reported that mathematics teachers are influenced by their beliefs about mathematics and mathematics teaching. The interactions of teachers' knowledge with knowledge of pedagogy and students cognition are vital elements that influence classroom behaviour within a given context (Fennema & Franke, 1992).

Campbell, Smith, Boulton-Lewis, Brownlee, Burnett, Carrington and Purdie (2001), stressed that in a classroom that adopted the combination of student centered and teacher directed learning, the learning potential of the constructivist aspects of the class will be recognized by students with deep approaches to learning. However, the students with surface approaches often lacked this understanding, and remained focused on classroom routines that emphasize the transmission of knowledge and rote learning. Taylor *et al* (2005) explained that children who view their teacher to be a mentor rather than a transmitter of knowledge will take an active role in their learning. Evidence had shown that teachers holding constructivist view of mathematics would likely to allow students to explore and investigate while teachers reside in their classrooms as facilitators thus adopting a teacher-student interaction mode of instruction (Suggate & Goulding, 1998). According to Williams & Baxter (1996), the teacher is no longer the only source of knowledge and students need to contribute actively to the understanding in the classroom.

Problem solving is central to teaching for constructivist mathematics teachers (A. G. Thompson, 1992). Children's mathematical learning are enhanced by adopting a range of problem solving strategies (Hawera, Taylor, Young-Loveridge, & Sharma, 2007). So therefore, supporting a child's in a teacher-centered classroom is consistent with traditional methods of teaching, which so many teachers had experienced when they were in school (Fraivillig, Murphy, & Fuson, 1999). A person's perception of the nature of mathematics underpins that person's view of how teaching should take place in the classroom (Hersh, 1986). As Fraivillig (1999) has pointed out, developing of children's conceptual understanding of mathematics requires teacher knowledge about both mathematics teaching and children's mathematical thinking.

It is well documented in practical research on teachers beliefs that there is a widespread perception of mathematics as a collection of distinct rules and procedures (Ernest, 1989; A. G. Thompson, 1992). Ball (1990) reported that aspiring elementary teachers believed that doing mathematics means applying memorized formulas and procedures to textbook exercises and view mathematics as a rigid discipline. Moyer (2001) in her study involving 10 middle grade teachers in the United States reported that mathematics instruction in their classroom followed a script or lesson pattern where students spend most of their time acquiring isolated skills through practice hence learning is implicit through observation and participation. The teacher's main objective was the coverage of the state curriculum objectives. Taylor, Hawera and Young-Loveridge (2005) in their study found that a large group of NZ students (~45%) depended much on the teacher and tended to adopt a passive role in their learning.

The role of parents

It is generally argued that learning is a social process and the home is seen as both the starting and foundation for learning (Warren & Young, 2002). The NZ curriculum (NZ Ministry of Education, 2007) stated that all curriculums should "connect with the wider community and engage the support of the families, whanau and communities" (p.9). On the other hand the Fiji Ministry of Education Strategic Plan 2006-2008 (Ministry of Education, 2005) stated that "communities should be strengthened and empowered through partnerships with school leaders and teachers and increased opportunities for consultation" (p.13). The third theme of the Literacy and Numeracy Strategy stated that

links between the communities should be strengthened, encouraging and supporting family, whānau and others to help learners. Home-school partnerships in mathematics education in NZ is a government initiative but little consultation has been done so far to encourage or develop such partnerships (Eyers & Young-Loveridge, 2005).

According to Price (1997) students learning is improved when educators build bridges to parents who would then provide a solid education for all students. Researchers have argued that parents who are concerned in their children's education contribute not only to higher academic achievement, but also to positive behaviors and emotional development (Booth & Dunn, 1996; Hoover-Dempsey, Bassler, & Burrow, 1995). Parents who are also supportive with their children's mathematics learning contributed to their children's higher proficiency levels and positive attitudes than less supportive parents (Cai, Moyer, & Wang, 1997).

In order to understand how parents are involved in the education of their children, numerous researchers had been trying to describe the different types of support parents offer (Anderson, 1997; Hoover-Dempsey, Bassler, & Burrow, 1995; Peressini, 1998). Two groups of parental participation emerged from their study. There were parents who supported their children by participating in school activities and others assisted their children at home with their school work. Cai, Moyer and Wang (1997) in their study identified five parental roles in middle school learning of mathematics. They stated that parents are motivators, monitors, resource providers, mathematics content advisers and mathematics learning counselors. According to Merttens (1999) children's attitudes towards learning mathematics and study are acquired by the parents within the home environment. Studies have also shown that there is a positive relationship between achievement in mathematics with parental involvement in their children's schooling (Young-Loveridge, 1993; Young-Loveridge, Peters, & Carr, 1998). School policies and practices should regard highly the value of parental involvement in mathematics (Eyers & Young-Loveridge, 2005).

Atkinson (1999) suggests that parents may need to familiarize themselves to recent initiatives in order to be involved with teachers and children to raise mathematics achievement. The rationale behind the Literacy and Numeracy Strategy is that children

need to become numerate in order to contribute fully to society in the future. Parental involvement in this process is thought to be beneficial (Eyers & Young-Loveridge, 2005). Research suggests that conflicts may arise if the method being used by either child or parent is unfamiliar to the other while parents are assisting at home (Peressini, 1998). Cai *et al* (1997) argued that parents do not often understand the mathematics content their children are learning despite using mathematics everyday. Unless mathematics homework is related to current learning and which both parent and child can actively engage in, it can become a task of little educational value (Merttens, 1999; Peressini, 1998).

Baroody & Ginsburg (1990) explained that active learning of mathematics concepts may occur only if the learning material is connected to the knowledge of the student. However, when parents and teachers have very different ideas about what mathematics teaching should involve, home-school partnerships may be harmful in mathematics education (Eyers & Young-Loveridge, 2005). Young-Loveridge (1989) suggested that in addition to talking to family members about how parents help their children and their views about the nature of mathematics, “we need a more complete picture of what happens in families in terms of numeracy events” (p.57). According to Hoover-Dempsey *et al.* (2005) the role of the school was to take steps to motivate parental involvement and to support parents’ effectiveness in helping their children learn.

2.13 Attitudes towards mathematics

Mathematics in the New Zealand curriculum (Ministry of Education, 1992, 2007) stated that mathematics education aims to “develop in students the skills, concepts, understandings, and attitudes which will enable them to cope confidently with the mathematics of everyday life” (p.8). The views, attitudes and expectations of students regarding the teaching and learning of mathematics have been considered to be an important factor underlying their school experience and achievement (Borasi, 1990; Schoenfeld, 1985). McLeod (2006) refers to attitude as “affective responses that involve positive or negative feelings of moderate intensity and reasonable stability” (p. 581). Examples of attitudes towards mathematics according to McLeod (1992, 2006) would include liking geometry, disliking story problems, being curious about topology and

being bored by algebra. Likewise, Ma and Kishor (1997) define attitude towards mathematics as “liking or disliking mathematics, engaging in or avoiding mathematics, and holding the beliefs that one is good or bad in mathematics, that mathematics is useful or useless, easy or difficult and important or unimportant” (p.27).

Students can be motivated by whether or not they like the subject they are learning, the value they place on the subject, and the importance they see the subject has for their future (Chamberlain, 2007). New Zealand’s National Education Monitoring Project (NEMP), a longitudinal study assessing about 3% of eight and twelve year old students, looking at students’ knowledge, skills, motivation and attitudes, stated that students’ attitudes, interests and liking for a subject can have an impact on their achievement (see <http://nemp.otago.ac.nz>). The NEMP Mathematics Assessment Results 2005 reported that about 10 percent more year 8 than year 4 students have distinctly negative views about studying mathematics in school and their own capabilities, while 33 percent more year 8 than year 4 students are negative about doing maths in their own time. These patterns have stayed quite consistent from the first survey in 1997 to the 2005 survey.

Chamberlain (2007) when summing up NZ’s participation in three cycles of TIMSS at Year 9 reported that students in 2002/2003 held more definite views on whether or not they enjoyed mathematics compared to their counterparts in 1994/1995 and 1998/1999. A significantly higher proportion of students were more positive with their views in 2002 than in 1994. There was also a significant 12% point increase in the proportion not enjoying mathematics from 1994 to 2002 in spite of the increase in the proportion of students enjoying mathematics over the same period.

2.14 Self Assessment

On children’s perceptions of self as good in mathematics, Young-Loveridge (1992) reported that about a third (32%) of the children thought that they were definitely good at mathematics and a greater proportion of boys than girls thought they were good at mathematics (44% cf. 24%). It was interesting to look at the reasons children gave for their judgments of themselves as good or not good at mathematics. The children’s assessments of their own mathematical competence tended to be based on feedback (e.g.

ticks) for getting answers right rather than their own sense of accomplishment from successfully working out solutions to problems (Young-Loveridge, 1992).

Stuart (2000) acknowledges that mathematics is easily grasped by some students while majority struggle every step of the way. Franke & Carey's (1997) study involved thirty-six first graders in reform classrooms from 2 different school systems. The students participated in individual interviews to determine the children's stated perceptions regarding what it means to engage in mathematics and the rationale and conditions under which they held such perceptions. Franke and Carrey reported that these children held different perceptions of what it meant to succeed in mathematics, but success was not determined by speed and accuracy.

2.15 Solving mathematics problems

Problem solving is an important element of reform mathematics (NCTM, 2000; Wood, 2001; Ollerton, 2007). Through problem solving, students gain knowledge and the same time develop this knowledge (Ollerton, 2007). Krulik and Rudnik (1980) defined a problem as a situation that requires courage and which the individual sees no obvious means or path to obtaining the solution. Problem solving is more than just solving a problem. It is a method of enquiry and the process by which students experience the power and usefulness of mathematics in the world around them (NCTM, 1989). Jones (2004) emphasized that with reforms in mathematics classrooms, teachers are expected to create favorable learning environments, to use constructive mathematical tasks, to manage students' mathematical discourse and promote making sense. Ellis and Yeh (2008) in their study presented a problem to students that require the use of problem solving and mathematical thinking as students analyze and explore alternative methods. They reported that students who are analyzing algorithms and figuring out their own methods are really doing mathematics for they are solving problems and using reasoning.

Adeleke (2007) suggested that teachers should teach mathematics in a way that encourages the understanding of the required basic structure of mathematics. Evidence had shown that children have typically viewed mathematics as a set of rules and procedures in which problems are solved by applying computational algorithms that have been explicitly taught by the teacher. Students expect these algorithms to be fairly

routine tasks that require little reflection and yield correct answers (Frank, 1988; Garofalo, 1989). The environment to which learning mathematics takes place and the teacher instruction also influences how children think mathematics should be done. According to Ellis and Yeh (2008), traditional algorithms that are used for subtraction and multiplication are very effective but not very clear because they do not allow students to see why the methods work. Kamii and Dominic (1998) explained that algorithms are harmful because they encourage children to give up their own thinking and they “unteach” place value, making it hard for children to understand number sense.

Problem solving is at the centre of learning mathematics. Learners acquire mathematical knowledge through procedural and conceptual learning strategies (Adeleke, 2007). Rittle-Johnson, Siegler and Alibali (2001) described procedural knowledge as “the ability to execute action sequences to solve problems (p.346) and conceptual knowledge is “an implicit or explicit understanding of the principles that govern a domain and of the interrelations between units of knowledge in a domain” (p.346-347). According to Adeleke (2007) procedural knowledge enables students to implement the rule of equations to solve simultaneous equations while conceptual knowledge enables students to describe with understanding the rule governing equations and their solutions. The relationship between concepts and procedures is very important as students engage in mathematics learning. Learning with understanding can be viewed as making connections or establishing relationships either within existing knowledge or between existing knowledge and new information (Hiebert & Carpenter, 1992).

Evidence had shown that children can develop their own strategies easily and competently solve multiplication and division of two or more digits before school (Anghileri, 1989; Carpenter, Ansell, Franke, Fennema, & Weisbeck, 1993; Mulligan & Mitchelmore, 1997). For example, kindergarten and first grade students intuitively solve a range of problems involving joining, separating, or comparing quantities by using a collection of objects (Carpenter & Lehrer, 1999). Extension of these strategies can be used as the foundation for developing the concepts of addition, subtraction, multiplication and division (Carpenter et al., 1999). Thompson (1999) listed the most commonly used mental calculation strategies for addition and subtraction of numbers up to 20. These were strategies employed by a sample of young children who had not been

taught mental calculation and invented the strategies themselves. Thompson grouped them in two categories, strategies that involve counting, and those involving the using and deriving of number facts.

Studies have also focused on the counting and reasoning strategies children use to solve addition and subtraction problems (Clarke, Clarke, & Horne, 2006; Fuson, 1992). Fuson (1992) identified counting strategies which included count-all, count-back-all, count-down-to, and count-down-from. Reasoning strategies included doubles, near doubles, adding ten, adding nine, commutativity, combinations for ten, part-whole strategies, and retrieving answers from memory. Other studies have found successful problem solving with two digit numbers that depended on the children's ability to construct a concept of ten that is both a collection of ones and a single unit of ten that can be counted, decomposed, traded and exchanged for units of different value (Fuson et al., 1997; Young-Loveridge, 2000).

Researchers have been highlighting that fractions or rational numbers have relevance to our everyday activities. Evidence has shown that the difficulties students experience with fractions can cause problems with other domains in mathematics such as algebra, measurement, and ratio and proportional concepts (Lamon, 2007). The learning of fractions is an area of mathematics which children find particularly challenging (Moss & Case, 1999) hence the difficulties students experience with fractions are related to their complexity (Young-Loveridge, Taylor, Hawera, & Sharma, 2006). Young-Loveridge *et al* (2006) in their study interviewed 238 year 7–8 students in six intermediate schools who were given a task involving addition with fractions ($+$). They reported that only 32 students (13%) found a correct answer for the problem, and some of those solved it using procedural knowledge rather than a deep conceptual understanding of fractions. Half of the students gave an incorrect answer. The most common error, shown by almost a quarter of the students, was to add the numerators and/or denominators known as the “add across” error (Smith, 2002). More than a third of the students did not attempt the problem. . Lamon (2007) highlighted that research with students who have had at least five years of traditional instruction in mathematics shows that reasoning strategies tend to be replaced by rules and algorithms by the time students have been at school this long. It had also been argued that the idea of fraction equivalence is a key

component of the part-whole sub-construct for fractions (Behr, Lesh, Post, & Silver, 1983).

2.16 Ways of Exploring Children's Perspectives

The methods employed to obtain qualitative data on students perspectives is influenced by writers who have highlighted the importance of talking and listening to students in order to appreciate their unique perspectives (Young-Loveridge, 2005; Young-Loveridge & Taylor, 2005; Young-Loveridge, Taylor, Sharma, & Hawera, 2005). Interviewing is a tool used in mathematics education research that captures the multiple views and realities of the participants (Stake, 1995). The clinical interview allow the researcher to enter the learner's mind, and gain a clear understanding of the knowledge that the children use to make sense of their world (Hunting, 1997). In the process of interacting with the child, the interviewer develops an interpretation or a series of interpretations that help provide a new perspective on the child's thinking. Just as the child's thought is influenced by the interview, so is the interviewer's (Ginsburg, 1997a). The clinical interviews can be used to gather data on mathematical thinking, and also on children's beliefs and attitudes.

One-on-one clinical interviews with students have most typically been promoted for helping teachers understand how children think about mathematics (Buschman, 2001; Long & Ben-Hur, 1991). Interviews too, foster insight into how children think and reason, how children demonstrate their creative abilities and talents, and how they apply and use problem-solving strategies in mathematics (Buschman, 2001). The clinical interview can reveal insights in mathematical thinking and allows for individual differences when outlining mathematical concepts (Ginsburg, 1997b). It can truly help researchers and teachers to enter the child's mind in a sensitive manner. At the same time you should realize that the method is extremely difficult to use. It takes great skill and insight to monitor the child's motivation, to reword questions, and to invent discriminating experimental tests, especially when all of this needs to be done on the spot (Ginsburg, 1997a).

The difficulties of the clinical interview must not be allowed to detract from its value for research or practice. In both clinical interview and conversation, talk flows back and forth and is not “standardized” or routine, and often one person in the dyad tries to find out what the other thinks (Ginsburg, 1997a). Using a semi-structured interview for data collection in this research enables the researcher to develop ideas and speak more widely on the issues raised (Denscombe, 2003).

2.17 Qualitative Research

Qualitative research has no one methodology, no distinct set of methods, and no theory, or paradigm, that is distinctly its own (Denzin & Lincoln, 1998). Three data gathering strategies typically characterize qualitative methodology: in-depth, open ended interviews; direct observation; and written documents (including program records, personal diaries, logs, etc.). There are a variety of ways to report the results of qualitative research/evaluation; common among them is the sense of story – which includes: attention to detail, descriptive vocabulary, direct quotes from those observed or interviewed, and thematic organization. The use of open-ended interviews and direct quotes from those interviewed is where this research design makes its links.

2.18 Summary

The summary of studies reviewed in the literature provide insight into the views and reasons why children develop their views and attitudes towards mathematics and mathematics teaching and learning, and factors that attributes to it. To date there has been no research in Fiji using the student voice in a classroom setting so that teachers and policy makers could gain deeper insights into children’s unique abilities and learning needs that may lead to more responsive teaching and give children the opportunity to engage in their own learning individually or as a group.

2.19 The purpose of the study

This study explores the Fiji and Pasifika students’ perceptions of mathematics and their attitudes towards mathematics learning.

CHAPTER THREE: Method

3.1 Statement of the Research Question

This study explores the Fiji and NZ Pasifika students' perceptions of mathematics and their attitudes towards mathematics learning.

3.2 Participants

3.2.1 The students

The participants in this study consisted of 48 intermediate school students. Thirty-six students were from Fiji and included 24 Year 8 students aged 13 and 12 Year 7 students aged 12. Twelve Year 7 and 8 students from New Zealand also participated as respondents. One group of Fiji participants were interviewed in September of 2006, and the other group in March 2007. The researcher was also interested on the impact of the Fiji national examinations on the views of the children (September 2006-after FEYE and March 2007-before FEYE). The year 2006 is identified with the letter "A", and 2007 with the letter "B". The students were identified according to their country of residence, gender, age, and mathematics ability, as judged by their teacher - high achiever, average or low achiever (see Table 1) and an individual number. For example, FM8HA3, a Fiji male student, in Year 8 (aged 13), was a high achiever interviewed in 2006 and participant number three; and NF8AB6, a New Zealand female student, in Year 8 (aged 13), was an average achiever, interviewed in 2007 and participant number six.

The class teachers were asked by the researcher to select students from a range of mathematics ability levels (ie. high, average and low achiever). An attempt was also made to involve the same number of females and males. This was quite difficult as the majority of students (21/48) who consented to take part in the interview were females.

Table 1: Number of participants showing their country of residence, gender, Year level and age, mathematics ability, year of interview and their ethnicity

ID	Country	Gender	Year /Age	Matrix	Year	Ethnicity
	Fiji (F); NZ (N)	Male(M) Female (F)		High/Average/ Low	2006(A) 2007(B)	
FF8HA1	F	F	8/13	High	A	Fijian/Kiribati
FF8HA2	F	F	8/13	High	A	Fijian
FM8HA3	F	M	8/13	High	A	Fijian
FF8HA4	F	F	8/13	High	A	Fijian/Tongan
FF8HA5	F	F	8/13	High	A	Rotuman
FF8HA6	F	F	8/13	High	A	Rotuman
FF8AA7	F	F	8/13	Average	A	Fijian
FF8AA8	F	F	8/13	Average	A	Fijian
FM8AA9	F	M	8/13	Average	A	Fijian
FF8LA10	F	F	8/13	Low	A	Fijian
FF8LA11	F	F	8/13	Low	A	Fijian
FM8LA12	F	M	8/13	Low	A	Fijian
FM8HB1	F	M	8/13	High	B	Fijian
FF8HB2	F	F	8/13	High	B	Indo-Fijian
FM8HB3	F	M	8/13	High	B	Fijian
FM8HB4	F	M	8/13	High	B	Fijian
FF7HB5	F	F	7/12	High	B	Fijian
FF7HB6	F	F	7/12	High	B	Fijian
FF7HB7	F	F	7/12	High	B	Fijian
FF7HB8	F	F	7/12	High	B	Fijian
FM8AB9	F	M	8/13	Average	B	Indo- Fijian
FM8AB10	F	M	8/13	Average	B	Fijian
FF8AB11	F	F	8/13	Average	B	Rotuman
FF8AB12	F	F	8/13	Average	B	Fijian
FF7AB13	F	F	7/12	Average	B	Fijian
FM7AB14	F	M	7/12	Average	B	Fijian
FF7AB15	F	F	7/12	Average	B	Fijian
FM7AB16	F	M	7/12	Average	B	Fijian
FF8LB17	F	F	8/13	Low	B	Fijian/Tongan
FM8LB18	F	M	8/13	Low	B	Fijian
FM8LB19	F	M	8/13	Low	B	Rotuman
FF8LB20	F	F	8/13	Low	B	Fijian
FM7LB21	F	M	7/12	Low	B	Fijian
FM7LB22	F	M	7/12	Low	B	Fijian
FF7LB23	F	F	7/12	Low	B	Fijian
FF7LB24	F	F	7/12	Low	B	Fijian
NF7HA1	N	F	7/12	High	A	Tongan
NF7HA2	N	F	7/12	High	A	Fijian
NM8HB3	N	M	8/13	High	B	Samoan
NF8HB4	N	F	8/13	High	B	Fijian
NF8AB5	N	F	8/13	Average	B	Tongan
NF8AB6	N	F	8/13	Average	B	Samoan
NF8AB7	N	F	8/13	Average	B	Samoan
NM7AB8	N	M	7/12	Average	B	Samoan
NF7LA9	N	F	7/12	Low	A	Fijian
NF7LA10	N	F	7/12	Low	A	Tongan
NM7LA11	N	M	7/12	Low	A	Fijian
NF8LB12	N	F	8/13	Low	B	Tongan

3.2.2 The schools

The study in NZ was carried out in two intermediate schools in Hamilton city. The five participants who were interviewed in 2006 were from a decile 3 school³ with a total roll of 788 children. The other seven children interviewed in 2007, were from a decile 4 school with a school roll of 621 students. Of the 12 NZ students, seven were females and five were males, and there were four high achievers, four average and four low achievers. The 36 children from Fiji were from a large urban primary school in Suva with a total roll of 950 children. Twelve children were interviewed in 2006 and the other 24 children in 2007. The medium of instruction in this school is English, the participant's second language.

3.3 Procedure

A semi-structured interview was used to explore the participants' perceptions of mathematics and their attitudes towards mathematics learning. The interview was adapted from Young-Loveridge, Taylor, Hawera and Sharma (2005) and Global Strategy Stage (GloSS): Form B (Ministry of Education, 2006), (see Appendix A). The interview was carried out in English, and at times Fijian was used with the students from Fiji when more clarification was needed. It also allowed more flexibility, giving the interviewer the opportunity to probe if required.

The researcher emphasized to the respondents that she was only interested in finding out about "how kids learn maths and how teachers can help them", and "what kids themselves think about learning maths". The children were asked questions about a range of topics they had been studying in mathematics, including their views on group work, the importance of knowing and sharing solution strategies with others, the nature of mathematics, the people who supported their mathematics learning, their attitudes

³ A school's decile indicates the extent to which it draws its students from low socio-economic communities. Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities. Decile 10 schools are the 10% of schools with the lowest proportion of these students.

towards mathematics, how good they thought they were at maths and tasks to assess their mathematical problem solving (see Appendix A for further details).

The participants were interviewed individually in a separate room. Each interview sessions was approximately 30 minutes and was audio-taped for later analysis. Participation in the interview was voluntary and all participants had consented to participate and given permission for the interview to be taped. Each taped interview was transcribed, and where Fijian was used, it was then translated into English.

3.4 Data Analysis

The interviews were transcribed and the transcripts were read and re-read to identify common themes, ideas, words and patterns. A systematic analysis was then made of all 48 transcripts. The frequencies with which categories were referred to by students were then calculated in percentages and shown in tables. The tables showed the numbers and percentages of students who responded in various ways. Some responses by students were coded in more than one coding category if they referred to more than one idea. Hence the totals add up to more than 100%. Selected excerpts from the transcripts had been presented to illustrate each of the coding categories and also help to illustrate the quantitative analysis.

3.5 Ethics

The research proposal, letters and information sheets were approved by the Ethics Committee of the University Of Waikato School Of Education prior to the study. A letter explaining the research and seeking permission to work in the school was sent to each principal. A similar letter was also sent to the teacher (see Appendix B). Confidentiality was assured to all participants.

CHAPTER FOUR: Results

4.1 Introduction

Findings from the interview were categorized into seven sections according to the questions that the researcher had chosen to focus on and the responses organized under several sub-headings. These were according to the children's responses on their views on whether or not people should work in groups, importance of knowing others' strategies and explaining one's strategies to others, their views on the nature of mathematics, people who supported their maths learning, their attitudes towards mathematics, how good they thought they were at maths and their ability as assessed by their teachers on the given tasks.

A systematic analysis was made of all the 48 transcripts and the frequencies of which categories were referred to by the students were then calculated in percentages. The tables showed the numbers and percentages of students who responded in various ways and it should also be noted that some responses by students were coded in more than one coding category if they referred to more than one alternative. Thus the totals add up to more than 100%. In addition to the tables, selected excerpts from the transcripts had been presented to illustrate each of the coding categories. These excerpts throw light on the students own sentiments and helps to illustrate the quantitative analysis.

4.2 Learning mathematics individually or collectively

Prior to the question that was the focus here, the children were asked if they had groups for maths and if so, which maths group they were in, why did they think they were in that group, how much did they contribute during group work and whether their teacher knew they were contributing or not. They were then asked to respond to the given question and the reasons for their responses:

Do you think that people should work at maths on their own, or should they work in groups? Why?

The responses of the students on how they thought they should work in mathematics indicated that there was substantially more support that people should work in groups rather than working individually (see Table 2). Overall, almost four-fifths of the students

thought that they should work in a group while only one-fifth opted to work individually. The majority of the Fiji students (ie. 32/36) thought that they should work in a group. It was interesting to note that under half of NZ students (ie. 5/12) thought that people should work “on their own”.

Table 2: Numbers of students who gave various ways on which they thought people should work in groups or work on their own

Participants	Fiji A	NZ	Total
<u>People should work in groups</u>			
Cognitive processes			
-learning	5	3	8
Mathematical processes			
-communication	5	2	7
-alternative strategies	1	-	1
-problem solving	2	-	2
Social processes			
-help each other	11	-	11
-those who know to help those who don't	6	2	8
-reciprocity	1	-	1
No Idea	1	-	1
Total	32 (89%)	7 (58%)	39 (81%)
<u>People should work on their own</u>			
Dishonesty	-	2	2
Easier to work alone	1	-	1
Show own effort	1	1	2
Suspicious	1	-	1
Individuality	-	1	1
Better learning	1	1	2
Total	4 (11%)	5 (42%)	9 (19%)

The responses of the 48 interviewees indicated the extent to which they thought that people should work in groups or individually. In the interviews an effort was also made to try and unearth why students held their particular views (see Table 3). The students responded to the question about their thoughts on how people should work in mathematics in a variety of different ways. Most of the students' explanations seemed to link to mathematics learning that occurs in their classrooms daily. The students talked about cognitive processes such as learning, mathematical processes like problem solving and communicating mathematical ideas, and social processes such as interaction, help-seeking and help-giving. In the following section, reasons for why students supported

group work are presented first and followed by the reasons on why they thought that people should work on their own.

4.2.1 Support for working in groups

Overall the majority of the students (ie. 32/36 Fiji & 7/12 NZ) thought that people should work at mathematics in groups and gave a range of views on why they think that people should work in groups. The responses of the students tended to focus on processes and these were subdivided into cognitive processes such as learning, or on mathematical processes such as communication and problem solving, and social processes such as helping each other.

Cognitive processes

Eight of the 39 students (ie. 5/36 Fiji & 2/12 NZ) mentioned that learning results from engaging in group activities. Five of them commented that it was easier to learn from peers:

It is easier to learn and your classmates can help you with stuff you don't know (NM8HB3)

The teacher can just explain once to the group and it is also easier to learn with friends (NF8AB7)

Better learning was mentioned by one student who responded that she preferred group work:

If you are stuck on a question then you always have someone to help you learn maths better (FF8HA6)

One child specifically mentioned that working in a group was about having fun and learning at the same time:

You can have fun and at the same time you're learning maths (NF8AB5)

The other students' comment tended to be brief as the example below shows:

You can learn from each other (FF8LB20)

Mathematical processes

Ten of these 39 students (ie. 8/36 Fiji & 2/12 NZ) talked about mathematical processes such as communication of mathematical ideas and problem solving in their responses. Seven of them referred to communication and said that that group work was about learning to respond to ideas and also respond to the ideas of others. For example:

You learn others ideas and how they get their strategies (NF8AB6)

When we come across a problem that we do not know, we can all work together and come up with ideas on how best to work it out (FM8AB9)

One of these students mentioned different ideas and different strategies, but said that there will be only one answer:

It is much faster to get to an answer and there will also be many ways and different explanations but there will only be one answer (FF7HB5)

Two out of 10 children who commented on mathematical processes said that working in a group was about drawing on each other's strengths in problem solving:

People will find out new ways of solving problems from each other (FF8AA8)

Social processes

Twenty of the 39 children (ie. half of Fiji & one-sixth of NZ) commented that working in a group was about helping one another, or giving help when you know it, or seeking help when you don't know it. Eleven of these 21 children (who were all from Fiji) mentioned that they thought that people should work in a group to help each other and seven of them gave little explanation for their views as the example below shows:

We can help each other to find the answer (FF7AB15)

Another four of these 11 students stated that when working in a group, the smart ones would help the slow learners as FF8HA2 explained:

To help those children who still do not know how to do subtraction and all those.... we need to interact with others in a mixed ability group (FF8HA2)

Eight of the 21 children (ie. 6 Fiji & 2 NZ) who mentioned social processes in their responses said that they thought that people should work at mathematics in groups so as

to seek help from their peers. Five of them said that in a group people who understand the question will explain the work to them and gave responses similar to FM7AB14:

Those who understand the question can help those who do not (FM7AB14)

Three of these 8 students indicated that they thought people should work at mathematics in groups so they could seek help from friends as the example below shows:

You can ask your friends when you do not know how to work out the answer (FF7LB23)

One Fiji child out of 21 children mentioned the idea of reciprocity and said that people should work at mathematics in groups as you are expected to take turns between being the helper and the person being helped:

We get help when you don't know what to do and when you know what to do you can help those who don't (FF7HB8)

No Idea

Only one student out of 39 who also preferred to work in a group could not explain why she held that view:

We should work in groups (F8LA11)

4.2.2 Support for working individually

Four Fiji students and 5 New Zealand thought that people should work at math their own. Two NZ students seemed to be particularly concerned about dishonesty as the example below shows:

Work individually because people who are not good at maths copy and get all the answers (NF7HA1)

One child from Fiji commented that it might be easier to work alone than to work with others:

If they find it easier to work alone then I think it is OKAY.... (FF8HA4)

Two students were adamant that learning mathematics was about individual effort and persistence:

I think they should work on their own to try and give them the effort so that they could learn how to do it (FF8HA5)

They should work on their own to see how they go (NF7LA9)

One child who thought that people should work at mathematics alone seemed suspicious of the level of help friends in a group might give her:

We should work alone so that we write down our own thinking. In groups your friends might give you the wrong answer to copy down (FF7AB16)

Another child thought that individuality was important:

Because it will give you independence to try and get everything right (NF7HA2)

Learning mathematics better was also mentioned by two students who also thought that individuality was important:

I want to learn how to do it by myself. I also learn better and understand more when I work alone (NM7AB8)

4.2.3 Patterns of responses

The reasons given by the students on their support for working in a group or working individually could be classified into five groups (see Table 3). Five patterns of responses emerged from the reasons students give when asked why they think they should work in groups or individually. Three of these patterns were from the students who supported working in a group and the other two patterns from those who supported working alone.

Table 3: *Various patterns of responses that emerged from the reasons given by students on whether or not they support group work*

Patterns that emerged from reasons given by students	Fiji	NZ	Total
1. Mutual helpers	17	4	21
1. Givers or helpers	6	-	6
2. Recipients of help	6	2	8
3. Individualistic	3	3	6
4. Distrustful	1	2	3
5. Other reasons	3	1	4
Total no. of students	36	12	48

Overall nearly half of the students who support group work gave reasons that could classify them as “mutual helpers”. The students in this group commented that they support group work because they could learn mathematics from each other. Six students could be classified as “givers or helpers”. They said that they should help those who don’t know mathematics. Another eight students gave reasons that indicated that they were “recipients of help” as their reasons on why they support group work.

With those students who support working individually, 3 of them could be classified as “individualistic” who prefers to learn mathematics alone while the other 4 gave reasons which could classify them as being “distrustful”. They mentioned dishonesty and that learning mathematics while interacting with their peers was a form of cheating or copying.

4.3 Importance of knowing and sharing solution strategies with others

The interviewer also asked the students to comment on how they checked their answers, an on the importance of knowing and sharing their solution strategies with others’. The interviewer was also interested in why they held particular views:

Do you think it is important for you to know how other people get their answers? Why? Is it important for you to be able to explain to other people how you worked out your answer? Why?

It was noted that the children’s responses to the questions varied from group to group (see Table 4). Almost seven tenths of Fiji students but less than half of the NZ students agreed that it was important to know others strategies. On the question of how important it is to explain to other people how you worked out your answers, almost all of the students (ie. 33/36 Fiji & 11/12 NZ) felt strongly that it was important to share their strategies to their peers, while only a few thought that it was not important.

The responses of the students to the interview questions revealed the extent to which they view communication as important for their mathematics learning. In the interviews, an effort was made to find out *why* students held particular views.

Table 4: The numbers and percentages of students who responded to the question about knowing and sharing solution strategies with others'

	Participants	Fiji	NZ	Total
Importance of knowing others' strategies				
Yes		25 (69%)	5 (41%)	30
No		11 (31%)	6 (50%)	17
No Idea		-	1 (8%)	1
No. of Students		36	12	48
Importance of explaining ones' own strategies to others				
Yes		33 (92%)	11 (92%)	44
No		3 (8%)	1 (8%)	4
No. of students		36	12	48

In the following section, students' responses to the question about knowing about others' solution strategies are presented (first those who thought it was important, then those who thought otherwise). A matching section on the importance of explaining one's solution strategies to others follows.

4.3.1 Importance of knowing others' strategies

Thirty of the 48 students (ie. 25/36 Fiji & 5/12 NZ) felt strongly that it was important to know others' solution strategies and gave a range of reasons to their particular views. Four of the 30 children mentioned the usefulness of having alternative strategies as the reason that knowing others' strategies was important as the examples below show:

To find out if there's another way to figure it out that they might have (NF7HA2)

One student mentioned that the reason for knowing others' strategies was that having alternative strategies might be worthwhile for the future:

So that you can know other strategies which are different from yours that may help you later (FM8LB18)

Another student seemed more concerned about the speed of the solution and gave the reason for knowing others strategy as being the shorter the method the less the time needed to solve a problem:

Their working out might be shorter which saves time (FF7HB8)

Four others mentioned that their peers might have an easier strategy and gave similar responses:

If your method is hard and theirs is easier, you will be able to use the easiest one (FM8AB10)

The idea of reciprocity was mentioned by two Fiji students as the reason that knowing others' strategies was important:

If they don't have the right one, you can help them or they help you (FM8AB10)

There are different strategies to work out an answer. If they have a strategy that is shorter and different from mine, I will try to copy it down so that I know it too. If mine is shorter, I will ask the teacher to copy it down on the blackboard for the others to copy (FM8HB1)

Another student seemed more concerned about knowing others' strategies to make sure that they were on the same level:

To see if I am doing the same strategies as the people in my group and see that we are on the same page (NF8AB6)

Seven of the children thought that the reason for the importance of knowing their peers' strategies was that it was valuable for their own learning of mathematics:

You can learn from them because they have a different strategy from yours (FF7HB5)

Three students seemed more concerned with the correctness of their answers as the example below shows:

Because they may be doing it the right way and you are doing yours differently (FM8HB3)

Four students commented on checking their answers as the reason for knowing their peers' solution strategies:

If your working out is wrong you can check from them (FF8AA9)

One student thought that getting the same answer was important:

So that we can have the same answer (FF8AB11)

Two of the students mentioned that it was important to know others' strategies only when you do not understand the problem:

If you don't know, then you can follow their way (FF8LA12)

Knowing others' strategies is not important

Seventeen of the 48 students (11/36 Fiji & 1/2 NZ) who thought that knowing others' solution strategies was *not* important and they had a range of different reasons for their views. Four of these students referred to dishonesty as the example below shows:

Some people may not do the work and just copy (FM8HB4)

One Fiji student seemed more concerned about examination preparation:

It will not help you if you are preparing for the examinations. If you copy from your friends you will not know anything (FM7LB21)

Another four students thought that individuality was very important:

Other people might have their way, a hard way and a smart way and I have my own way (NF7LA9)

Individual effort with the correct answer was mentioned by one of the students:

Basically it is how you get the answer right and not how the other does it, for they might be doing it differently (NF8AB5)

Another student referred to privacy as the reason that knowing others' strategies was not important:

Because it is really just me, about me and not them (NM8HB3)

Two of the students thought that knowing others' strategies was not helpful to mathematics learning:

Because that will never help and we should do our own (FF7LB23)

One student who thought that knowing others' strategies was not important rated himself highly:

I don't have to because I am good at it (NM7AB8)

Another two students disagreed with the statement that knowing others' strategy was important but could not explain why they held that view:

No, it is not important (FF8LA12)

Only one of the children (NZ student) was unsure whether or not it was important to know how other people got their answers:

I don't know (NF7LA10)

4.3.2 Importance of explaining ones' strategies to others

It was interesting to note that the two groups of participants all had the same (high) level of agreement from the students about the importance of explaining ones' strategies to others (92%). Forty-four of the 48 children (ie. 33/36 Fiji & 11/12 NZ) expressed affirmative responses "yeah" or "yes" (see Table 4) to the question about the importance of sharing their solution strategies with their peers. Seven of these students referred to helping others with their learning:

If you are explaining to someone who does not know how to work out the answer, it will help that student (FM8LA12)

Five other students also referred to helping others with their learning but gave little explanation for their views:

Yes, so everyone else can learn off you (NF7HA1)

Four students seemed concerned about making sure that other students understood their strategies:

So that they can understand how you do it (FF8LB19)

Five others commented that explaining one's strategies to others was about helping their peers in solving problems:

So that they can be able to solve their problems too (FF8HA1)

The value of alternative strategies was mentioned by four students:

So that they can use my method to find their answer (NF8LB12)

Three students referred particularly to the value for their own learning:

It is good to explain your answer to your friends because you can learn more (FM8AB9)

Another three students' responses indicated that the reason for helping others with their learning was that they were proficient and confident in mathematics:

It builds up my confidence in teaching others (FF8HA2)

Another four students indicated that the reason for explaining their strategies to others was that they had the right answer:

To help them if they are wrong and you can teach them another way so that they get it right (FF7HB6)

Reciprocity was the reason given by one student for explaining his strategies to others:

You are helping them, and they will help you when you don't know it (FM7AB14)

One student mentioned that explaining one's strategies to others might help in recalling the mathematical process used to solve another problem:

Because if you can explain how you worked it out, then you can do it again (NF8HB4)

The value of learning from one's mistakes was mentioned by two students:

So that they know they have a mistake and then they learn from it (NM8HB3)

One student thought that explaining one's solution strategies to others might inform friends that they needed help:

Because if we get it wrong, our friends will know and they will help us (FF7LB23)

Another three students seemed more concerned about the need to prove to others that they knew how to solve the problem themselves:

It's important to explain it because people might ask you how you've done it and they might think you are cheating or using calculators (NF7HA2)

Two other students (ie. FM7LB22 & FF8LA11) also agreed that it is important to explain one's strategies to others but could not explain why they held that view.

Explaining ones strategies to others is not important

Four of the 48 children (ie. 3/36 Fiji & 1/12 NZ) disagreed with the idea that knowing others' strategies is important and gave detailed explanations for their view. Two Fiji students referred to dishonesty as the example shows:

Some of them just copy, and some I have to explain it to them so that they understand, which is annoying (FF7HB8)

Another Fiji student referred to individuality and the focus was on the national examination:

I do not have to because it will not help anyone. For example, when it comes to the exams, I will not be explaining to anyone, and we will have to work individually (FF7AB16)

The other student referred to the difficulty encountered when explaining one's strategies to others:

You can't help them by giving them the answer and it's quite hard to explain it because they don't get it (NM7AB8)

4.4 Views about the nature of mathematics

The students were asked about the nature of mathematics and what they thought mathematics was all about. If students didn't respond to the question then they were asked to say what they would tell someone about what maths is.

What do you think mathematics is all about? (If you were going to tell someone about what maths is, what would you say to them?)

The 48 interviewees responded to the question reflecting their views about what mathematics is in a number of ways (see Table 5). Some students interpreted the question by reflecting on their mathematics learning in the classroom commenting on the aspects of mathematical content, cognitive processes like learning and thinking or on mathematical processes such as problem solving, developing knowledge and strategies. A few students interpreted the question in terms of the purpose of mathematics being helpful now and also in the future. Only one student referred to enjoying mathematics and another two students were unable to give any response at all.

Aspects of mathematical content were consistently mentioned by the two groups on what they thought mathematics was all about. It was noted that slightly more than one-third of Fiji students (ie. 14/36) and two-thirds of NZ students (ie. 8/12) mentioned number in their responses. Eight Fiji students (ie. 8/36) made reference to the aspects of

operations while only two NZ students (ie. 2/12) referred to it. Fewer students made references to the general cognitive processes such as learning and thinking while a substantial number of Fiji students (ie. 14/36) with only 2 NZ students mentioned mathematical processes such as problem solving. A few students made reference to other mathematical processes such as developing knowledge and strategies. One Fiji student mentioned the usefulness of mathematics to him now. A few students (ie. 4 Fiji, and 1 NZ) referred to the usefulness of mathematics for the *future* in terms of getting a job. It was discouraging to note that enjoyment of mathematics was mentioned by only one NZ student.

Table 5: *The numbers and percentages of children whose responses to the question about the nature of mathematics fell into particular categories*

ASPECT MENTIONED	FIJI	NZ	Total
<u>Mathematical content</u>			
▪ numbers	14 (39%)	8 (67%)	22 (46%)
▪ operations	8 (22%)	2 (17%)	10 (21%)
<u>Mathematical processes</u>			
▪ learning	3 (8%)	1 (8%)	4 (8%)
▪ thinking	2 (6%)	-	2 (4%)
▪ problem solving	15 (42%)	2 (17%)	17 (71%)
▪ strategies	2 (6%)	1 (8%)	3 (6%)
▪ knowledge	-	1 (8%)	1 (2%)
<u>Usefulness</u>			
▪ everyday use	2 (6%)	-	2 (4%)
▪ future use	6 (17%)	1 (8%)	7 (14%)
<u>Enjoyment</u>			
	-	1 (8%)	1 (2%)
<u>Non-responders</u>			
	2 (6%)	-	2 (4%)

4.4.1 Mathematical Content

A large number of students (ie. more than one-third of Fiji students and two-thirds of NZ students) referred to particular aspects of mathematical content in their responses to the question asking what mathematics is about. They spoke about the aspects of number:

Maths is work of numbers (NF7HA1)

One student mentioned algebra and geometry explicitly, while another student talked about studying shapes:

Maths will have a range of things like Algebra; Geometry etc. Maths also includes numbers (NF7HA2)

It's all about numbers and studying shapes (M8HA3)

None of the Fiji A students mentioned the aspects of operation while some of the Fiji B students and a few NZ students referred to it:

Maths is about addition, subtraction, multiplication and division of numbers (FF7HB8)

4.4.2 Processes

The two groups of students referred to mathematical processes in their explanations. A few students referred to general cognitive processes such as learning and thinking.

Learning

Three Fiji students and only 1 NZ student referred to learning in their responses on what they thought mathematics was about:

Briefly, I will just say that it is learning about stuff (F8HA5)

It is where you can have fun, learn new things (NF7LA9)

Thinking

Another two Fiji A students commented that the nature of mathematics was about thinking and using the brain:

Maths is like a brainteaser (FF8LA12)

Maths is a subject where you have to use your brain and concentrate well in order to understand it (FF7A16)

4.4.3 Problem solving

A considerable number of students spoke about mathematical processes such problem solving and a few hinted that the nature of mathematics is about developing knowledge

and strategies. Six Fiji A, 9 Fiji B and 2 NZ students specifically mentioned problem solving:

It's about solving problems (F8AA9)

Mental computations were mentioned by two students who responded that mathematics is all about:

Calculating numbers mentally all the time (F8LA12)

A subject that can help you in many ways. When you go to the shop you can just calculate mentally how much change to get back (FM8HB1)

The importance of being fast was mentioned by one student:

It is about fast calculations (F8HA2)

Two students mentioned that the nature of mathematics was also about accuracy:

It includes a lot of focus and concentration so that you would solve equations correctly and if there are mistakes, some buildings might collapse and kill people. Some people might ask: How did this building collapse? Maybe it is due to the poor mathematical calculations of the architects who build it (F8AA8)

4.4.4 Knowledge and strategies

Four students commented that the nature of mathematics was about developing knowledge and strategies. Three of these students specifically mentioned alternative strategies and gave brief explanations for their views as the example shows:

Maths is a subject where you have several different ways of solving a problem. Your friend will have a different strategy from yours but the two of you will come to the same answer (FM8LB18)

A student said that mathematics was about knowledge but gave no explanation for her view:

Maths is knowledge (NF8AB7)

4.4.5 The usefulness of mathematics

Ten students spoke about the usefulness of mathematics. Only one of them (FM8HB1) was concerned about the immediate use of mathematics referring to the importance of mental calculation when out shopping:

A subject that can help you in many ways. When you go to the shop you can just calculate mentally how much change to get back (FM8HB1)

The other nine students considered the nature of mathematics to be about how beneficial it was for the future. Four of the 9 students' responses about the usefulness of mathematics for the future were in relation to getting a job and gave comments similar to FF8HA5:

Briefly, I will just say that it is learning about stuff that helps you get a job because most of the jobs nowadays need you to know maths (FF8HA5)

Another two students gave a slightly more detailed explanation about the importance of mathematics in relation to when they get a job as the example shows:

It's about calculations as when you grow up you will be able to calculate your salary and the distance you have to travel to go to work. At work you need to calculate the length of wires and power points needed if you are dealing with them. You also need to know how much to spend on bus fare and the change to get back...say if you give the driver \$5 (FF8HA1)

The other three students (FM8AB10, FF8LB20 and FM7LB21) spoke about the importance of mathematics for the future but had difficulty in expressing themselves:

Maths is very important for your future (FF8LB20)

4.4.6 Enjoyment

Only one participant mentioned that mathematics was where you learn new things and have fun:

It's where you can have fun and learn new things especially in using numbers (NF7LA9)

4.4.7 Non-responders

Two students (FF8LA11 and FF8AB11) indicated that they had no view at all about what mathematics is and gave comments such as:

I just don't know (FF8AB11)

4.5 People who support mathematics learning

4.5.1 Teachers

The students were asked to identify people who supported them in their mathematics learning and to describe how they were helped. First they were asked about how they thought their teacher helped them learn mathematics:

How do you think your teacher helps you learn maths?

The students' responses reflected the extent to which they thought their teacher supported them in their mathematics learning. These responses have been organized according to various themes unfolding from the data (see Table 6).

Table 6: *Numbers and percentages of students who gave various ways their teachers supported their mathematics learning*

Teacher help	Fiji	NZ	Total
Shows strategies	19 (53%)	-	19
Teacher behavior	10 (28%)	6 (50%)	16
Mathematics skill	-	1 (8%)	1
When we don't understand	5 (14%)	3 (25%)	8
Show effort	1 (3%)	1 (8 %)	2
No idea	-	1 (8 %)	1
No response	1 (3%)	-	1
Total	36	12	48

Show strategies

Nineteen of the 48 children mentioned that their teacher often helped them by showing them strategies for doing mathematics. It was interesting to note that all these students were from Fiji. Five of these 19 children indicated that the teacher wrote a particular strategy on the chalkboard and they had to keep on practicing the strategy or ask questions until the task is understood as the example shows:

She breaks it down on the blackboard with simple workings so each and everyone could understand. If we still don't know, we can raise our hands and give her the question that we don't know and she will help us (FF8HA5)

By writing down an example to follow on the chalkboard. If we still do not know, she will rub it off and then we do it again until we understand it (FM8HB1)

One of the students who mentioned that the teacher wrote the strategy on the chalkboard indicated that it was so that she could copy it:

The teacher writes down the examples on the chalkboard and I copy it down (FM8LB18)

Another five students indicated that the teacher helped them by showing an example on how to work it out of the chalkboard:

She writes on the chalkboard and explains how to do it to us (FF7AB15)

One student indicated that the teacher helped her by showing the strategy and its importance in the examinations:

She helps us by showing us the formula, how to work it out and tells us not to forget it because it will come in the exams (FF7HB7)

The other seven of the 19 students who mentioned that the teacher helped them by showing them strategies to do mathematics, referred explicitly to the teacher explaining their solution strategies to them:

She explains to us on how to do the task and the easiest method to use to get the answer (FF7HB5)

Teacher's behavior

Sixteen of the 48 children (ie. 10/36 Fiji & 6/12 NZ) talked about their teacher's behavior. Three of these children recalled that the teacher often explained the work that was to be done as the example shows:

She tells us what to do and then we do a couple together on the mat. Then we go off and work individually. If we need help then she will come around (NF8HB4)

Another child mentioned that the teacher was someone who gave tasks that challenged them:

Each day she gives us tasks that challenges us (NF8AB6)

One child indicated that her teacher helped her mathematics learning by sharing clues:

She comes around and gives you clues to answers you don't know that might help you (NF8LB12)

Two Fiji children who also commented on the teacher's behavior described their teacher as someone who helped by giving notes about the topic to copy:

She helps us with the notes she gives and what is in the book (FF8HA6)

She explains to us on how to solve the given problem and give us notes to copy so that we know more about the topic (FF8HB2)

Another two students referred to the teachers' classroom organization:

She puts us in our groups and helps us on what she can do (NF7HA1)

Normally we have a pre-test to find out what we are good in and that is how she grouped us. Then she tries to find out what we need to work on and we work it out ourselves (NF7HA2)

Four of these students who were all from Fiji gave responses on the teachers' behavior that showed the importance of the textbook as a resource:

She will tell us to copy down the examples that are in the textbook and then give us work to do from that textbook (FM8HB4)

She explains it clearly and once she is sure that everyone knows it, she will let us do the given activities from the textbook (FF7HB8)

Another three students described their teacher as someone who checks for their understanding by correcting their work and then offering help:

I try to do it all by myself and she will come and check. She will tick the ones I got right and then she will help me with the ones I get wrong teaching me the easier way of doing it (NF7LA9)

Mathematics skills

Only one out of 48 children commented that the teacher is someone who helped her develop mathematics skills especially with the times table and that was a child from NZ:

She helps me with my times table as it is part of an equation (NM7AB8)

When we don't understand maths

Eight of the 48 students mentioned that the teacher helped them when they don't understand the questions and gave similar comments as the example below shows:

If I don't understand anything I will ask and she will help me do it (FF8LA11)

Giving a chance

Two students referred to the teacher giving them the chance to try the problem first, and then offer help:

Most of the time when we don't know, the teacher keeps on explaining that stuff. If he knows that we still do not get it, he will let us do more activities. If we still don't know, then he will try to help us individually (FF8HA4)

She helps me "one-on-one" where it's just me and the teacher. She will then tell me what to do, I work it by myself and ask the teacher if it is right or wrong (NM8HB3)

No idea about the teacher's role

One of the students (NM7LA11) did not seem to have any idea of how the teacher helped him and another student (FF8AA7) did not respond to the question on how their teacher helped them with their mathematics learning.

4.5.2 Support from friends or peers

The interviewer also asked the children about other people, whether or not they help them with their mathematics learning and how:

What about other people? Do they help you learn maths? How?

The responses of the 48 students reflected that nearly all of them received some form of help with their mathematics learning from their friends or peers in school. (see Table 7). Forty-four of the 48 students (ie.32/36 Fiji & 12/12 NZ) expressed affirmative responses, "yeah" or "yes" that others in their class helped them. The other four students, all from Fiji said that they were not helped at all by their friends or peers.

Table 7: *Numbers and percentages of students showing their responses whether or not they were helped by others in their mathematics learning*

Participants	Fiji	NZ	Total
Help from friends	32 (89%)	12 (100%)	44
No help	4 (11%)	-	4
<i>No. of students</i>	36	12	48

An effort was made in the interview to find out students' views about how they were helped (see Table 8).

Table 8: Numbers of children whose responses fell into each of the categories of types of help from others

Types of help from others	Fiji	NZ	Total
Showing strategies	19 (53%)	3 (25%)	22
When teacher can't help	5 (14%)	1 (8%)	6
Provides an answer	1 (3%)	3 (25%)	4
Can work with	3 (8%)	2 (16%)	5
Valuing others' strategy	1 (3%)	1 (8%)	2
Providing tasks	1 (3%)	1 (8%)	2
Share clues	1 (3%)	1 (8%)	2
Provides work to copy from	1 (3%)	-	1
No mention of help	4 (11%)	-	4
Number of students	36	12	48

Types of help from others

Twenty-two of the 44 children (ie. 19/36 Fiji B & 3/12 NZ) commented that their friends helped by showing a strategy or a way to do their mathematics and gave similar comments as the examples show:

My friends...like when I ask them they will show me how to do it (FF8AB12)

Six students viewed friends as people who help them when the teacher is not there or when they had forgotten what the teacher wanted of them:

My friends help me when the teacher is not there. They correct me when I am wrong and if I am doing it the wrong way they will teach me the right way (FF7HB5)

Instead of going to the teacher all the time, just ask your friends who know it to help you (NF8HB4)

Four students' responses indicated that their friends provided them with an answer:

Yes, the girl next to me would help me and if we are doing a test she would call out the answer (NF7LA9)

Another five students viewed friends as peers who they could work with and gave similar comments as the example shows:

When I don't get it and one of my friends do, I just ask them and they help (FF8HA4)

Two of the students' responses indicated that knowing others' strategies is important:

If they know how to work it out then we will see each others work and if we don't agree then we will go and see another person in class (FF8HA6)

Two children saw friends as people who provide them with tasks that help them with their mathematics learning:

They ask me a question and I have to figure it out quickly (NF7HA1)

My friends help me by giving me the problems to answer, and then they check whether it is right or wrong (FF8LB19)

Two children said that friends helped by sharing clues:

When I don't know they will help me by giving me a clue on how to work it out (FF8HB2)

My friends tell me parts of the answer and I will work it out myself (NM7AB8)

One child from Fiji viewed friends as peers who provided them with their written work to copy:

When I am not in school then they will give me their books to copy (FM7LB24)

No mention of help from friends

Four of the 48 students (FM8HA3, FF7HB7, FF7AB16 and FF8LB17) made no specific mention of friends in school helping them with their mathematics learning.

4.5.3 Support from people at home

The students were also asked about the people at home who help them learn mathematics, and how they help them learn:

Is there anyone at home who helps you learn maths? How?

The responses of the students revealed the tremendous support given by their immediate family members who included their mothers, fathers, siblings, and also their extended family members such as uncles, uncles and cousins to help them in their mathematics learning (see Table 9)

Table 9: *Numbers of children responses whether or not people at home help them with their mathematics learning*

Participants	FIJI	NZ	Total
Help from home	34 (94%)	10 (83%)	44
No help from home	2 (6%)	2 (17%)	4
No. of students	36	12	48

Forty-four of the 48 students (ie. 34/36 Fiji & 10/12 NZ) quickly responded that there were people at home helping them with their mathematics learning (see Table 10 above). Only four students (ie. 2 Fiji & 2 NZ) responded that there were no people at home to help them with their mathematics learning. The interviewer also attempted to find out how they were helped (see Table 10 below).

Table 10: *Numbers of students who gave various ways other people helped their mathematics learning*

How people at home helped	Fiji	NZ	Total
Show strategies	9 (25%)	3 (25%)	12
Mathematics skill	2 (6%)	3 (25%)	5
Giving problems	-	2 (17%)	2
Homework	3 (8%)	1 (8%)	4
Teaches me	6 (17%)	-	6
Explain the work	3 (8%)	-	3
Same as friends	4 (11%)	-	4
Various ways	2 (6%)	1 (8%)	3
No mention of the type of help	5 (14%)	-	5
No help	2 (6%)	2 (17%)	4
Number of students	36	12	48

Showing how to work it out

Twelve of the 44 students' responses indicated that people at home helped them with their mathematics learning by showing them strategies or how to work it out as the examples below show:

They tell me how to work it out. For example, we were doing the "interest rate" and they showed me how to calculate the 10% VAT (Value Added Tax) on food items (FF8HA6)

He will teach me another strategy different from the one in the textbook and easier to follow (FM8HB1)

Mathematics skills

Five children mentioned that people at home helped them to develop particular mathematics skills:

She (Mom) makes us learn our times table (NF8HB4)

Yes, my father helps me in addition and multiplication (FF8LB20)

Giving problems

Two NZ children mentioned being given problems to solve to help them with their mathematics learning as the example shows:

She gives me some questions to solve and checks them (NM7AB8)

Homework

Four children referred to family members who helped them with their homework:

They help me with my homework. They show me how it is supposed to be done and why that way (FF8HA5)

Teaching

Six Fiji children commented on how people at home helped by teaching them and gave similar comments to the examples shown:

I show her the exercise that I have to do and then she teaches me (FF8AA7)

Able to explain

Another three Fiji students saw family members as people who were able to explain the work:

They explain to me how to work out the given problem (FF8LA10)

The same help as friends give

Four students mentioned that people at home provided the same help as their friends in school do (FF7HB6, FF8AB12, FF7AB13 & FF8LB19). They made similar comments

on how people at home helped them that “they give me the same help as my friends in school do”.

Other

One child mentioned his work being checked to see whether it was right:

They check my work and tell me whether it is right or wrong (FM7LB22)

A child mentioned being asked to recall what was learnt and revise it:

They will always ask me on what I learn on that day and I will revise it (FM8HB4)

Another child commented that she had been helped to get better at mathematics:

My big brother helps me because he wants me to get better (NF7LA9)

Helped but did not describe how

Five students (FF8HA2, FF8HA4, FF8LA12, FF7HB8 & FM8AB9) also mentioned being helped by their family members, but did not specifically indicate the type of help received.

No help at home

Four students commented that no one at home helped them with their mathematics learning as the example shows:

I don't really do my work because no one helps me (NF7LA10)

4.6 Attitude towards mathematics

The students were also asked to rate their feelings towards mathematics on a three-point rating scale with happy, neutral and sad faces (see Appendix 1).

Which face matches how you feel about maths most of the time? Are you happy, sad or in-between?

It was noted that nearly half of Fiji students and half of NZ students said that they were happy about mathematics most of the time (see Table 11). The other Fiji and NZ

students said that they were always neutral most of the time. It was interesting to note that none of the students chose the sad face.

Table 11: *Number of children showing the various faces that they choose*

Participants	FIJI	NZ	Total
Happy	15 (42%)	6 (50%)	21
Neutral	21(58%)	6 (50%)	27
Sad	-	-	-
Total	36	12	48

Overall, of the 48 participants, 21 of them said that they were always happy while the other 28 students gave comments to say that they were always neutral most of the time. An effort was also made in the interview to find out the reasons for their choice.

How come you choose that [SAY: happy, sad or middle] face?

They gave various reasons for their choice (see Table 12). In the following section, students’ responses on their choice of the happy face are presented first and then followed by their responses for their choice of the neutral face.

4.6.1 Happy most of the time

Of the 48 participants, 21 students (15/36 Fiji & 6/12 NZ) mentioned that they felt happy about mathematics most of the time. Six of these 21 students chose the happy face because they love mathematics. Two of six students (FF8LA11& FF8LB20) commented that “they love maths” and another two (FF7HB6 & FM7LB22) said that “they like maths”. Another student (FF8HA1) chose the happy face, said he loved mathematics and that he was good at it, and FM8HA3 said that he was always happy.

Another four students’ responses indicated that they are happy because mathematics is easy to them as the example below shows:

I love it and I enjoy doing maths as it is easy for me (FF8HA5)

A child felt happy most of the time and commented about mathematics skill:

I like problem solving (FM8AB18)

Table 12: *Number of students showing various ways on their feelings about mathematics most of the time*

<u>Happy</u>	<u>Fiji A</u>	<u>NZ</u>	<u>Tot</u>	<u>Neutral</u>	<u>Fiji</u>	<u>NZ</u>	<u>Tot</u>
Love maths	6	-	6	No. of problems	2	-	2
Easy	2	2	4	Mixed moods	8	2	10
Mathematics skill	1	-	1	Hard	2	-	2
Fun	2	-	2	Understanding	4	-	4
Know what to do	1	-	1	Not doing well	1	-	1
Positive comments	1	-	1	Equipment	1	-	1
Value	1	-	1	Examples	1	-	1
Subject rating	-	1	1	Competition	1	-	1
Content	-	1	1	Boring	-	1	1
Positive attitude	-	1	1	Show strategies	1	1	2
Right answer	1	-	1	Teacher behavior	-	2	2
Relievers	-	1	1				
No. of students	15	6	21	No. of students	21	6	27

Two students' responses indicated that they enjoyed mathematics because it helps their thinking:

I like maths as it is fun and it sharpens my thinking (FM8HB1)

It is fun, hard and really challenging (FF8HB2)

A child liked mathematics and simply said that he knows what to do:

I now know what to do (FM8HB4)

Another child made reference to positive written comments from the teacher:

I always get a lot of good compliments in my book from the teacher (FF7HB7)

Valuing mathematics learning was commented at by a child:

Because maths is good for us to know (FF7AB15)

A child's comment indicated subject rating:

Maths is my best subject out of all (NF7HA1)

Another child who likes mathematics mentioned mathematics content:

I like maths because it involves numbers and shapes (NF7HA2)

Having a positive attitude was mentioned by one student who was happy about mathematics:

I am positive in my maths even though I am not good at decimals and fractions (NM7AB8)

Another student seemed concerned about getting the right answer:

When I do maths I always get it right (FF8AA7)

A child who responded that she was happy most of the time mentioned her dislike about relieving teachers:

I am always happy; it is only when we have relievers that I am unhappy (NF8AB7)

4.6.2 Neutral faces

Twenty-seven of the 48 students (ie. 21/36 Fiji & 6/12 NZ) chose that face that they always felt neutral about mathematics most of the time. They gave a range of reasons for their choice. Nine of these 27 students' responses indicated the rapid changes in their moods while learning mathematics for example, when it was easy they were happy and when it was hard they were sad as the example shows:

When it is easy for me, I am happy and when it gets hard, I am sad (FF8AB11)

I am happy when it is easy for example when I am just drawing shapes, but I am sad when I am dividing numbers and that is hard for me (FF7LB23)

Two students said that their feelings were always neutral because there were too many problems to solve:

Sometimes when there are too many problems to do, I am not happy (FF8HA2)

There's a lot to do and we don't finish because there are other lessons. We have to take the extra work home as our homework and I don't like it (FM8HB3)

A child mentioned that making a mistake gave him a sad feeling:

The equations are very hard to get and when I make a mistake, I am sad (FF8AA8)

Three children said that at times they didn't understand the given problems and that was why they felt neutral most of the time:

Sometimes when I don't understand the problem I am sad then I try harder and when I do know I am so happy (FF7HB5)

One child just saw that she was not doing well with her mathematics learning:

I see that I am not doing very well in maths (FM8LA12)

Another child's response indicated that she values using equipment:

Sometimes I like it, that is when I am using equipment to help me learn maths and at times, I don't (FF7HB8)

Another child mentioned feeling frustrated with mathematics learning:

Half of the time, I am sad because I am frustrated with it, and the other half, it is fun (FM8AB9).

Two Fiji children gave responses that indicated their dislike for showing their working out:

To me maths is not fun like other subjects. I am happy when it comes to marking to see that I have the right answer. To show the working out that is when I am sad because I don't like it (FF8AB12)

Many times I hate maths because the workings to do are too long and hard. At times the examples given are not clear and I don't always know how to do it (FM8LB18)

One child mentioned the differences between the mathematics topics:

Some topics are hard to understand. Even after the teacher explains to me, I will still not know it (FF7AB16)

Another child felt in-between most of the time simply because mathematics was confusing to her:

Sometimes it is confusing and at times it is easy (FF8LB17)

Another child saw mathematics learning as boring:

I don't really like maths because at times it is boring (NF8AB5)

To show one's strategies to others was the reason one child felt neutral about mathematics most of the time:

I find it hard to show my strategies and there are times when I feel great about what I've done and other times I think I had not done much in one session (NF8AB6)

Another child seemed preoccupied with mathematics competition:

I always come second or third in a maths competition in our class (FM7LB24)

Two students' responses indicated that the teacher's behavior contributed to their neutral feelings about mathematics most of the time:

When it comes to maths, I would not be listening to the teacher because she would be talking about boring ways that would not make it interesting, and everything does not make sense to me (NF7LA9)

The teacher just leads us to books and we don't learn much out of it (NF8LB12)

4.7 Self Assessment

The interviewer asked the students to assess themselves on how good they were at maths (see Appendix 1). They were asked to choose from one of five boxes showing “*very poor*”, “*poor*”, “*average*”, “*good*” and “*very good*”.

How good are you at maths? Which one will you choose from the above box?

The two groups of participants showed a marked difference in their views about how good they were at mathematics (see Table 13). Overall, only one-eighth of the participants saw themselves as “very good”, almost half of the students (22) said that they thought they were “good”, one-third of the students (16) saw themselves as “average” and one-twelfth of the students (4) saw themselves as doing poorly in mathematics.

Table 13: *Numbers and percentages of student's views regarding how good they are at mathematics*

Self Assessment	Fiji A	NZ	Total
Very Good	5 (14%)	1(8%)	6
Good	16 (44%)	6 (50%)	22
Average	14 (39%)	2 (17%)	16
Poor	1(3%)	3 (25%)	4
Very Poor	-	-	-
<i>Total</i>	36	12	48

In the interviews, the researcher was also interested to find out how they knew they were that good at mathematics. The students were asked:

How do you know that?

Students' responses to the interview questions reflected the range of factors that exist within the learning environment in which they were assessing themselves. The responses of the students who thought that they were *very good* and the reasons for their choice are

presented first, followed by those who thought they are *good*, *average* and lastly those who thought that they are *poor* in mathematics.

4.7.1 Very good in mathematics

Six of the 48 students saw themselves as *very good* in mathematics. Two of these students thought that getting the right strategies and the right answer was an indicator of how very good they were at mathematics:

My strategies are always right and when I share it with others' they get it right too (FM8HB1)

A child's response indicated that she was being rated by the teacher:

My teacher says that I am this (points to Very Good) (FF8HA6)

Another child who also regarded the teachers' comments as an indicator of her ability also mentioned the importance of the mark that she achieved in a test:

I usually get over 90 in the exams and I always get "good" as a comment from the teacher in my book (FF7HB6)

One child saw the mathematics ability group that he belonged to as an indicator of how very good he was at mathematics:

At school I am in the highest group with three other people (NF7HA1)

No comment

FF8HA5 also said that he thought he was very good at mathematics but could not explain how he knew that he was that good.

4.7.2 Good in mathematics

Twenty-two out of 48 children (16/36 Fiji & 6/12 NZ) rated themselves as *good* in mathematics and also gave a range of reasons for their views. Nine of these twenty-two students (all Fiji students) saw the marks that they had achieved in an exam as an indicator of how good they were at mathematics as the examples given below shows:

I always pass the entire maths test with high marks (FF8HA1)

I have always come out on top during the exams for example in the last trial test I scored 82% and the one next to me only scored 72% (FM8AB10)

In the annual exam last year I scored 98% and in the mid-year 90% (FF7HB7)

Six students commented that getting the right answer was a way of knowing how good they were at mathematics:

I do the working and I get it right so I'm good (FF8AA7)

When it comes to doing problems I always get the answers right (FF7HB7)

Two NZ children saw the groups they belonged to as an indicator of their ability in mathematics:

Most of the time I am in the top group or second top group (NM8HB3)

I am not in the lowest group (NF8AB5)

One child mentioned the amount of work that they were given in a group as indicative of how good at mathematics she was:

When we go into our groups the teacher will give us more work than the others (NF8HB4)

Another child referred to help seeking:

I have improved a lot. Those who used to be smarter than me are seeking help while I am not (FM8HB4)

One child saw the ability to solve a question as being an indicator of how good she was:

Most of the time when the teacher asks a question I will know how to solve it (FM7AB14)

Valuing the assessment comments on a report was mentioned by one child:

I just got my report and everything is at the expected level and some of them are beyond the expected level (NF7HA2)

Another child commented on mathematics skills as an indicator of how good she was mathematics:

I know all my times table (NF8AB7)

4.7.3 Average in mathematics

Sixteen children rated themselves as average in mathematics and also gave a range of reasons for why they held that view. Five of these students referred to the number of

right answers as a way of knowing how good they were at mathematics as the example below shows:

I don't always get all right but one or two mistakes (FF7AB13)

Four Fiji students rated themselves according to the marks they got in the examinations:

When I look at my marks it is in the 60's and 70's (FF8LB17)

Another four students made comparisons and saw that they were neutral most of the time:

Some of the tasks I know how to do it and others I don't (FF7AB16)

One child saw the fact that she relied on others for her mathematics learning as an indicator that she was an average student:

I am not good because I ask help from people who are really, really good at maths (FF8AA8)

Two students who also rated themselves as average learners said that they just thought that they were only that good in mathematics:

I don't know and I think I am just normal at maths (NM7LA11)

4.7.4 Poor in mathematics

Four of the 48 students rated their ability in mathematics learning as poor. One of them saw her ability in the mathematics test as an indicator of how good she was with her mathematics learning:

During the last test I scored only 22% and if I was good, I would have scored above 70% (FF8LB19)

Another child mentioned her feelings and the negative comments from her friends:

Like in my class that I don't actually want to be in it because they make fun of me when I get the wrong answers and they will tell me "Oh! You are really bad at maths" (NF7LA9)

One child said that she knew she was doing poorly in mathematics because of the group that she was in:

Because I am in the lowest group after doing these tests that we have to do (NF8LB12)

Another child who rated herself as poor in mathematics did not explain much about why she held that view but said that she just knew it:

I just know it (NF7LA10)

4.8 Solving problems

The students were then given word problems (see Appendix 1) to work out mentally and were asked to explain how they worked out their answers. They were also allowed to use pen-and-paper when they asked for it. The students' responses to the three questions were organized under several major headings. The students attempted three tasks: Question 1: $\$37 - \$9 =$; question 2: $\frac{3}{4} + \frac{7}{8} =$; and question 3: $81 \div 3 =$. The students that could only attempt Question 1: a backup problem ($9 + 4 =$) to solve to ensure that they finished with an experience of success.

4.8.1 Subtraction

The 48 participants used a range of strategies to work out question 1 (see Table 14 below). It was interesting to note that the majority of Fiji students relied on the algorithmic approach as a strategy to solve the problem. The New Zealand students mentioned a variety of counting strategies and part-whole strategies such as bridging through ten, reversibility, and compensation, when asked to explain how they worked out their answer.

Table 14: *Number of students who responded in particular ways to the Subtraction Task*

Strategies	Fiji	NZ	Total
Imagined the algorithm	10	1	11
Wrote the algorithm	15	-	15
Counting	2	1	3
Bridging through ten	2	5	7
Reversibility and compensation	-	2	2
Symbols	-	2	2
No explanation	3	-	3
Incorrect answer	4	1	5
<i>Number of students</i>	36	12	48

4.8.1.1 Algorithmic Approach

For question 1: ($\$37 - \9), twenty-six of the 48 students (ie. 25/36 Fiji & 1 NZ) worked out an answer using the algorithmic approach. It was noted by the interviewer that the students either imagined the algorithm or requested pen and paper to write the algorithm

when responding to question 1. The responses of the students who imagined the written algorithm are discussed first followed by those that actually used the written algorithm.

Imagined the Algorithm

Eleven of the 26 students who used an algorithmic approach to work out the answer imagined the vertical written algorithm. Four of them clearly explained how they worked out $\$37 - \9 as the examples below shows:

I used regrouping because 7 is less than 9 so I take 10 from there (pointed to the 3 in 37) and that one is 17 minus 9 equals 8 and the answer is \$28 (FF8HA2)

\$28....I took away 9 and 8 is left, there will be 2 tens left (pointed to the 3 in 37), bring down the 2 tens and that is 28 (FF7HB6)

I put the 9 under the 7, so I crossed off the 7 made into a 17 make the 3 into a 2 so 17 take away 9 is 8 and that is a 2 (points her finger at the crossed off 3) equals \$28 (NF8LB12)

Six students (FM8HA3, FM8LA11, FF8LA12, FM8HB1, FF8HB2 & FM8HB3) also imagined the vertical algorithm. The interviewer observed the students saying under the breath 17. When asked by the interviewer how they worked out the answer, they could only mention that they had to subtract \$9 from \$37 because it was the amount spent. They gave comments similar to FM8HB1:

Subtract 9 from 37 and that is \$28 (FM8HB1)

One child who also said 17 under her breath counted aloud and counted on from 9 folding her fingers to keep a note of how many numbers were said:

10, 11, 12, 13, 14, 15, 16, 17. Eight, so the answer is 28 (FF7HB8)

Wrote the Algorithm

Fifteen of the 30 students who worked out the answer with an algorithmic approach tried to work it out mentally but then thought otherwise and asked for a pen and a piece of paper. Five of these 15 students (FF8HA5, FF8AA8, FM8HB4, FF7HB7 and FF8AB11) had a similar strategy to that of FF8HA6:

(FF8HA6)

Another four students (FF8AB12, FF8LB20, FF7LB21 and FM7LB22) who solved the problem with a written algorithm had similar strategies to that of FF8HA6 but counted aloud when subtracting 9 from 17. They counted on from 9 folding their fingers to keep a note of how many numbers were said. For example, FF8LB12’s response:

10, 11, 12, 13, 14, 15, 16, 17 (says 8 and wrote down 28) (FF8LB12)

FF7LB23 counted all when taking 9 away from 17. She counted all her ten fingers and seven toes to make 17 and then touched the 7 toes and 2 fingers counting all from 1. She counted the left over 8 fingers and then wrote down 8.

Another child used a combination of part-whole strategy known as “reversibility” and “compensation” when subtracting 9 from 17:

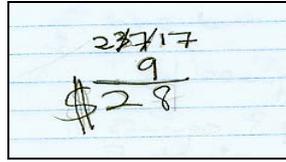
I added 1 to 9 and that was 10 and then add 8 which is 18 and minus 1 to get back to 17 (FM7AB16)

One child seemed concerned about the correctness of her answer after she wrote it down. The interviewer observed her counting up, starting at 28 keeping a note of how many numbers are said:

29, 30, 31, 32, 33, 34, 35, 36, 37... Nine that is how much she spent so the answer is \$28 (FF8LA10)

Another two students (FF7AB15 & FF8LB17) had a similar strategy. They crossed off the three tens and wrote two in front of it, then crossed off the 7 and wrote a new number seventeen beside it. The interviewer observed they could be heard as they whispered saying 10. It appeared to the interviewer that they were counting up. For 17 –

9, they started at 9 and counted up to 17 keeping a note of how many numbers they had said. Eight numbers were said and they wrote down 8:


$$\begin{array}{r} 27-9=17 \\ 9 \\ \hline \$28 \end{array}$$

(FF8LB17)

4.8.1.2 Counting strategy

Three of the 48 students (FF8AA7, FM7AB14 & NF8AB7) used a counting strategy for early addition known as “counting back from” and kept a note of the nine numbers said by folding nine fingers and opened them one by one when they were counting. For example FF8AA7’s response below:

\$37 subtract 9.....36,35,34,33,32,31,30,29,28 so the answer is \$28 (FF8AA7)

4.8.1.3 Bridging through ten

Seven students (FF7HB5, FM8AB9, NF7HA2, NM8HB3, NF8HB4, NM7AB8 & NM7LA11) used a type of part-whole strategy known as “bridging through ten” and gave comments similar to NF7HA2 below:

7 from the 9 and then left with 2 more, took \$2 off 30 and left with \$28 (NF7HA2)

4.8.1.4 Standard place value partitioning

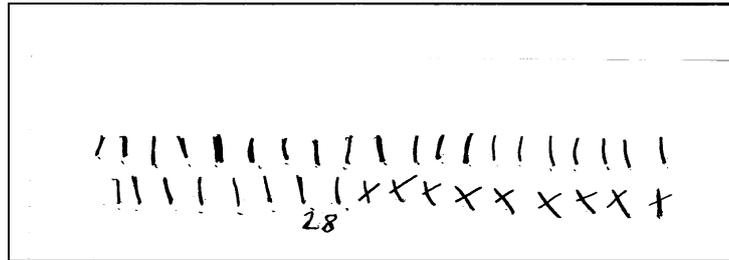
Another two children also used another type of part-whole strategy known as “standard place value partitioning”:

Just take away 9 from 30 and that’s 21 and then add on 7 equals 28 (NF8AB5)

Rounded off 9 to 10 than take it away from 37 that makes 27 and add 1 on equals 28 (NF8AB6)

4.8.1.5 Version of concrete materials

Two out of 48 students (NF7LA9 and NF7LA10) requested pen and paper and drew 37 sticks counting aloud from 1 until they said 39. They then crossed out 9 by counting from the first stick until the ninth. They were “counting all” with materials as they counted one by one the remaining 28. For example:



(NF7LA9)

4.8.1.6 No explanation

Three students (FF8AA9, FM8AB10 & FM7LB24) when asked about how they worked out the problem only said \$28, paused for about four minutes and said that they could not explain their strategy.

4.8.1.7 Incorrect Answer

Five of the 48 students (FM8LB18, NF7HA1, FF8HA4 and FF7AB13 and FF8LB19) were unsuccessful with this problem. Two of them used the faulty “*smaller from larger*” strategy:

I just put 37 and 9 underneath and 9 take away 7 equals 2 and there is the 30 and put 2 beside it equals 32 (NF7HA1)

One of them rated as a high achiever was so fast as she imagined the vertical algorithm that instead of 2 tens she assumed there was 1 ten:

She had \$18. Well she had \$37 at first and then she spent \$9 so I took that away and it came to \$18 (F8HA4)

Another student (FF7AB13) solved the problem using a written algorithm, but took approximately five minutes to subtract 9 from 17 which she wrote down as equals to 6 and the answer as 26. FF8LB19, who also worked out question 1 using pen and paper, was also unsuccessful because he added \$37 and \$9 to get \$46.

4.8.2 Addition of unlike fractions

For question 2: ($\frac{3}{4} + \frac{7}{8}$), a marked difference between the abilities of the students was noted. Overall half of the 48 students gave a correct answer, including 8 from Fiji A, 14 from Fiji B and only 2 NZ students. Twelve students (2 Fiji A, 6 Fiji B and 4 NZ) gave an incorrect answer, and another twelve students (including 2 Fiji A, 4 Fiji B and half of the NZ students) asked if they could skip the question. The students' responses were organized according to the particular ways of adding fractions that they mentioned (see Table 16 below).

Table 15: *Number of students who responded in particular ways to the Addition of Fractions task*

Strategies	Fiji	NZ	Total
<u>Correct Answer</u>			
Used eighths as a common denominator with understanding	1	-	1
Used eighths as a common denominator with procedural explanation	5	2	7
Wrote algorithm with eighths as a common denominator	15	-	15
Used quarters as a common denominator	1	-	1
<u>Incorrect Answer</u>			
Added numerators and denominators; "add across error"	3	4	7
Multiplied the numerators and denominators	5	-	5
No attempt	6	6	12
<i>Total no. of students</i>	36	12	48

4.8.2.1 Correct answer

Used eighths as a common denominator

Three answers given by the students were judged to be correct, including $1\frac{5}{8}$, $6\frac{1}{2}$ quarters and 13 eighths. Twenty-four students (ie. 22/36 Fiji & 2 NZ) gave correct responses to the problem. These students used different approaches to find the correct answer. Twenty-three of these 24 students used eighths as common denominator before adding the two fractional parts, while only one student used quarters as common denominator. Four groups of students emerged from those that used eighths as a common denominator and were sub-divided into those who used language that seems to

have a strong conceptual understanding of fractions when describing their solution strategy, those who used language suggesting that they were describing a procedural approach, those who used an algorithmic approach with written explanation that appeared to have a strong conceptual understanding, and those who gave written answers that appeared to have a strong procedural knowledge about adding fractions.

Used eighths as a common denominator and had conceptual understanding

Two of the 23 students who used eighths as common denominator gave responses suggesting that they had a strong conceptual understanding of adding unlike fractions:

One quarter and one eighth that's three eighths left, so they ate one and five eighths (FF8HA2)

Divided into eighths and Sione eats 6 pieces while Tama eats 7 pieces so thirteen eighths are eaten altogether (NM8HB3)

Used eighths as common denominator and gave a procedural explanation

Six students used language in their responses that suggested the use of a highly procedural approach to solving the problem as the examples below show:

I added $\frac{3}{4}$ and $\frac{7}{8}$ but 4 and 8 are not the same so I have to change 4 to the same denominator as 8 by multiplying by 2, added them I got thirteen eighths which is an improper fraction so I divided 13 by 8 and came up with 1 and $\frac{5}{8}$ (FM8HA3)

I changed three quarters to eighths, multiplied by 2 and my answer was 6 over 8 and then I added it to 7 over 8 and that is 13 over 8 which I changed into a mixed number. I divided 13 by 8 and the answer is one and five over eight (FF8HB2)

I doubled 4 to get 8 so that means I have to double 3 and that is six eighths plus seven eighths equals 13 eighths, so How many 8's in 13 that is 1 (uses fingers counts up from 8 and said 9,10,11,12,13) and the answer is one and five eighths (FM7AB14)

Wrote the algorithm

Fifteen Fiji students renamed $\frac{3}{4}$ as six eighths and used eighths as a common denominator. These students and used the written algorithm that both indicated they had a strong procedural knowledge of adding unlike fractions. They rarely explained their written work but when asked just responded by saying the answer as one and five eighths. Seven of the 15 students used eighths as a common denominator (FF8HA1, FF8HA4, FF8HA5, FF8HA6, FF8HB3, FF8HB4 and FM8AB10) and provided written

explanations that showed that they had a strong conceptual understanding of fractions. They converted $\frac{3}{4}$ to $\frac{6}{8}$ mentally, added it to $\frac{7}{8}$, gave their answer as $\frac{13}{8}$, and then converted it to $1\frac{5}{8}$. For example FF8HA1's written work below:

The image shows handwritten work for student FF8HA1. On the left, there are two pie charts. The first pie chart is divided into 4 equal parts, with 3 parts shaded. The second pie chart is divided into 8 equal parts, with 6 parts shaded. To the right of the pie charts, the following equations are written:

$$\frac{3}{4} + \frac{7}{8}$$

$$= \frac{6}{8} + \frac{7}{8} = \frac{13}{8}$$

$$= 1\frac{5}{8}$$

(FF8HA1)

Another eight Fiji students (FF8AA9, FF7HB5, FF7HB6, FF7HB7, FF7HB8, FF8AB11, FF8AB12, and FF7AB16) used eighths as a common denominator in their solution strategy, seemed to have a strong procedural knowledge of adding fractions. They converted $\frac{3}{4}$ into $\frac{6}{8}$ by multiplying by 2, and then added $\frac{7}{8}$ to get $\frac{13}{8}$ as an answer. They then used long division to convert $\frac{13}{8}$ into $1\frac{5}{8}$. For example FF8AB11's written work given below:

The image shows handwritten work for student FF8AB11 on lined paper. The work is as follows:

$$\frac{3}{4} + \frac{7}{8}$$

$$\frac{3}{4} \times \frac{2}{2} = \frac{6}{8} + \frac{7}{8} = \frac{13}{8}$$

$$8 \overline{)13} \quad 1\frac{5}{8}$$

(FF8AB11)

Instead of multiplying by 2, FM7AB16 who also showed that he had procedural knowledge used repeated addition by adding $\frac{3}{4} + \frac{3}{4}$ to convert it to $\frac{6}{8}$ before adding on $\frac{7}{8}$. This is a misconception as $\frac{3}{4} + \frac{3}{4} = \frac{6}{4}$ and not $\frac{6}{8}$:

The image shows handwritten work for student FM7AB16 on lined paper. The work is as follows:

$$\frac{3+3}{4+4} = \frac{6}{8} + \frac{7}{8} = \frac{13}{8} = 1\frac{5}{8}$$

(FM7AB16)

Another child, FF7HB5 added $\frac{1}{4}$ and $\frac{1}{8}$ the parts not eaten. She wrote $\frac{3}{4}$ and $\frac{1}{4}$ beside it and then $\frac{8}{8}$ to represent 1 whole and then wrote down $\frac{7}{8}$ and $\frac{1}{8}$ beside it and then $\frac{8}{8}$. Then she calculated mentally and wrote $\frac{3}{8}$. She drew an arrow to $\frac{16}{8}$ the total eighths in two pizzas. From there she calculated her answer as $\frac{13}{8}$ because $\frac{3}{8}$ was not eaten out of a total of $\frac{16}{8}$:

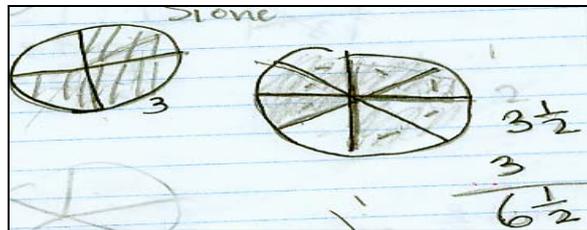
$$\begin{array}{r} \frac{1}{4} \rightarrow \frac{2}{8} \\ \frac{1}{8} \rightarrow \frac{1}{8} \\ \hline \frac{3}{8} \end{array}$$

$$\frac{16}{8} - \frac{3}{8} = \frac{13}{8}$$

(FF7HB5)

One of the 24 students whose answer was judged to be correct used quarters as a common denominator, changing $\frac{7}{8}$ into three and half quarters and then adding 3 to get six and a half quarters:

(Drew two pizzas) 3 pieces from the first one and $3\frac{1}{2}$ from the second, add them, so they ate $6\frac{1}{2}$ small pieces, quarter pieces (FM8HB1)



(FM8HB1)

Incorrect answer

Twelve of the 48 students who attempted the question were unsuccessful. Seven of them added the numerators and/or denominators while the other 5 multiplied the numerators and/or denominators: The seven out of 12 students (FF8LB17, FM7LB22, FF7LB23, NF7HA1, NF8AB5, NM7AB8 and NF7LA9) who added numerators and/or denominators made the “add across error” as they added three and seven for the numerator and four and eight for the denominator giving an answer of $\frac{10}{12}$. An example of FF8LB17’s response below:

$$\frac{3}{4} + \frac{7}{8} = \frac{10}{12} = \frac{5}{6}$$

(FF8LB17)

The other five out of 12 who had an incorrect response multiplied numerators and/or denominators. FF8AA7, FF8LA12, FF7AB13, FF7AB15 and FF8LB20 multiplied three by seven for the numerator and four by eight for the denominator giving an answer of 21/32. An example of FF7AB15's response is given below:

$$\begin{array}{l} 3 \times 7 = 21 \\ 4 \times 8 = 32 \end{array}$$

(FF7AB15)

No attempt

Twelve of the 48 students were reluctant to attempt the question because they perceived it was too difficult and asked to skip the question. These were two Fiji A students (FF8LA10 and FF8LA11), four Fiji B (FM8LB18, FF8LB19, FM7LB21 and FM7LB24) and six NZ students (NF7HA2, NF8HB4, NF8AB7, NF7LA10, NM7LA11 and NF8LB12).

4.8.3 Division

For question number 3: $81 \div 3$, 32 of the 48 interviewees were successful and gave a range of strategies (see Table 16). Twenty-six (11 Fiji A, 14 Fiji B and 1 NZ) children whose answer was judged to be correct used an algorithmic approach to get an answer. The responses of the students indicated that they had strong procedural knowledge of division, as could be seen by their written explanations. The other 6 children with the 2 Fiji B students made drawings and counted in groups of 3 while the 4 NZ students used a part-whole strategy known as “tripling and thirding”.

Table 16: *Number of students who responded in particular ways to the Division task*

Strategies	Fiji	NZ	Total
<u>Correct Answer</u>	22	-	22
Wrote the algorithm			
Imagined the algorithm	3	1	4
Counting in threes/skip counting	-	2	2
Tripling and thirding	-	2	2
Drawing	2	-	2
Wrong Answer	8	3	11
No attempt	1	4	5
<i>Number of students</i>	36	12	48

4.8.3.1 Wrote the algorithm

Although a total of 22 students solved the problem using pen and paper, two patterns emerged from their written explanation that showed that they had strong procedural knowledge about division. Eight students showed arrows to indicate that the 6 that they placed directly under the 8 as in 81 is 60 and 81 subtract 60 is 21. The other 14 children did not show any arrows and it seemed that they had strong procedural understanding of division with a good understanding of place values.

Shown arrows

Two Fiji A students (FF8AA7 and FF8AA8) and 6 Fiji B students (FM8HB1, FM8HB3, FF7HB6, FM8AB9, FM7AB13 and FM7AB14) used the long-division method to solve the problem and also used arrows to indicate the place value of 1. An example of FM8AB9's written explanation is given below:

$$\begin{array}{r}
 27 \\
 \hline
 3 \overline{) 81} \\
 \underline{60} \quad \downarrow \\
 21 \\
 \underline{21} \\
 0
 \end{array}$$

(FM8AB9)

Without arrows

Fourteen children showed that they had strong procedural understanding of division using the long-division method. Six Fiji A students (FF8HA4, FF8HA5, FF8HA6,

FF8AA9, FF8LA10 and FF8LA12) and 8 Fiji B students (FF8HB2, FF7HB5, FF7HB7, FF7HB8, FM8AB10, FM8AB11, FF8AB12 and FM7LB24) did not use arrows in their written explanation. They all had the same working out as FF8HA4:

(FF8HA4)

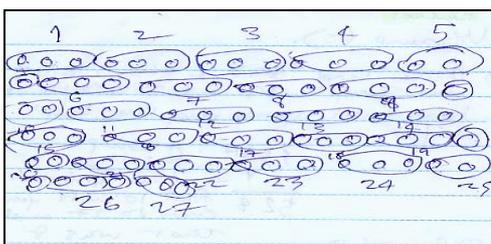
Imagined the algorithm

Four of the 32 students who did use mental strategies often just did the pen and paper algorithm in their head as the example shows:

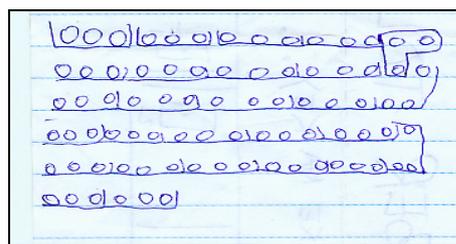
27 cans.....I divided 81 by 3 and 3 two's are 6 so 8 minus 6 is 2, bring down the one and 3 seven's are 21 and the answer is 27cans (FF8HA2)

4.8.4 Tally: Counting by ones with materials

Two students FM7LB21 and FF7LB23 rated as low achievers had another different strategy. They drew 81 balls counting one by one as they were drawing and then circled the ball in groups of three. Then they counted the groups which was 27:



(FM7LB21)



(FF7LB23)

4.8.5 Counting in threes or skip counting

Two NZ students used a counting strategy known as “skip counting” to divide 81 by 3:

I counted upwards in three's folding my fingers to keep note of the number of counts and that was 27 (NM7AB8)

I know that 3 times 10 is 30 and then I counted up in three's from 30 until I get to 81 and that was 27 times (NF8HB4)

4.8.6 Part-whole strategy known as “tripling and thirding”

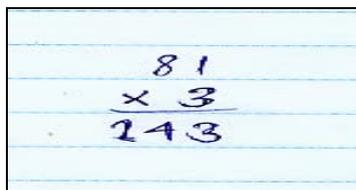
Another two NZ students used a type of part-whole strategy known as “tripling and thirding” to work out question 3:

9 times 9 equals 81 and 3 times 3 equals 9 so 3 times 9 equals 27 (NF8AB5)

27 cans because 9 times 9 are 81 so I times 3 and 9 to make 21 (NF8AB6)

4.8.7 Incorrect Answer

Twelve of the 48 students (ie. 8/36 Fiji & 4 NZ) who also attempted the question were unsuccessful and gave a range of strategies to solve the problem. Three of 12 students (FM8HB4, FF7AB16 and FF8LB22) multiplied 81 by 3. An example of FF7AB16's written explanation is given below:



A photograph of a student's handwritten work on lined paper. The student has written the multiplication problem $81 \times 3 = 243$. The numbers are written in blue ink. The '81' is on the top line, the 'x 3' is on the second line, and the '243' is on the third line, with a horizontal line drawn under the '3' in the second line.

(FM7AB16)

FM8LB18, FF8LB19 & FM7LB22, all rated as slow learners, added 81 balls and 3 cans to get the answer 84. However another two students (FF7AB15 & FF8LB17) subtracted 3 cans from the 81 balls to get the answer 78 while another two students (NM7LA11 & NF8AB7) gave an incorrect answer which was 39 and 9, and said that they just guessed.

4.8.8 No attempt

One Fiji A student (FF8LA11) and four NZ students (NF7HA1, NF7HA2, NF7LA9 & NF7LA10) asked if they could skip the question.

CHAPTER FIVE: Discussion

5.1 Introduction

This chapter discusses the findings from the seven key questions that had been chosen to be the focus of this study. The main areas of focus included the participants' views about their support for group work, the importance of knowing and sharing solution strategies with others, the nature of mathematics, the people who supported their mathematics learning, their attitudes towards mathematics, how good they thought they were at mathematics and their ability on subtraction, division and proportional problems. The main areas of focus were then discussed in relation to the purpose of the study which was to develop a deeper understanding of Fiji and New Zealand Pasifika students' perceptions and their attitudes towards mathematics.

5.2 Learning mathematics individually or collectively

Students' support for group work differed between the two countries (see Table 2). Nearly all of the Fiji students (ie. 32/36) supported learning mathematics collectively while just over half of the NZ students (ie. 7/12) preferred to work in a group. This finding may be explained by cultural factors such as cooperative effort and interdependence. South Pacific nations emphasize the group over the individual, and foster cooperative methods of problem solving rather than individual or solitary effort (M Clark, 2001). It seems that many of the NZ students of Pacific heritage had come to prefer individual work over group work. There are several possible reasons for this: (1) they may have adapted to western ways of life, in terms of classroom culture, (2) alternatively their preference for individual work may have been because of their lack of confidence in speaking English. As English is their second language that may have made it daunting for them to interact with others for fear of being humiliated for their limited English proficiency.

The general practice in the NDP is to have students working in groups so that learners are encouraged to share their strategies, listen to and challenge other children's ideas. The students who gain most from grouping situations are those who actively engage in

the discussion by asking questions or by answering questions of others (Brophy & Good, 1986). Pasifika students may be unaware of the benefits of group work, and may find this approach intimidating as they struggle to talk about mathematics as well as developing their mathematical understandings. The findings may also indicate the importance of working with a group of people you are comfortable with to give and share your ideas, as in the case of the Fiji students. Friendship and heterogeneous grouping also have their place in learning classrooms (Higgins, 2005).

The NZ students tended to be grouped by their dominant strategy stage by their teacher that is, working with students with the same ability including some of who may find it difficult to articulate their thinking. *NDP Book 3: Getting Started* (Ministry of Education, 2007) recommends that, teachers need to consider the personal characteristics of their students when forming instructional groups, including their ability to work collaboratively. Groups may be either homogeneous or heterogeneous but teaching students relevant skills necessary for successful group activities is important.

In exploring why students thought that they should work in groups or individually, from their responses five patterns of responses were identified, three patterns were given by the students who wanted to work in groups and two by students who preferred working on their own (see Table 3). The majority of the students gave as the reason for preferring group work, and was classified as being mutual helpers. This pattern was evident in the respondents' descriptions of their experiences of small-group work. For example, FF8HB2 (high achiever) said "you will learn much faster and it is also easier to learn from each other" and NF8LB12 (low achiever) said "you learn others' ideas and how they get their strategies". This is consistent with Trafton & Bloom's (1990) ideas that children learn through social interaction, by talking and actively exploring concepts with their peers, in whole class, small groups or individual activities.

The second category was classified as "givers or helpers". Their responses in the interview indicated help-giving was the reason behind their preference. For example FM8HA3 (high achiever) said "those who understand help those who are moving slowly and FM7AB14 (average achiever) said "those who understand the question can help those who don't". It seemed that these students may find that they learn more quickly

than others, teaching those who don't may lead to their own learning of mathematics better. The third reason given from the students who want to work in groups emerged from the students that were classified as "recipients of help". For example, NF7LA10 (low achiever) said "people in the group can help and you can ask them questions". Such responses indicate the reliance on peers to help them with their mathematics learning. These findings are consistent with Young-Loveridge (2005) idea that learning to communicate effectively depends on the presence of supportive participants who can scaffold and extend the learners' language as they grapple with more challenging ideas.

The fourth reason emerged from the students who preferred to work on their own and could be regarded as "individualistic". For example, FF8HA5 (high achiever) said that they should work on their own "to try and give them the effort so that they could learn how they do it" and NM7AB8 said "I want to learn how to do it by myself. I also learn better and understand more when I work alone". The findings suggest that, teachers need to be careful not to assume that all Pasifika students want to work co-operatively. All students should be encouraged to work in groups because they need social interaction to learn from each other and should be comfortable to communicate their thinking to their peers to enhance their performance in mathematics. Young-Loveridge (2005) also reported that many students are far from comfortable about communicating with peers about their thinking let alone appreciating the benefits of communication for their own learning.

The fifth reason which also involved students who did not want to work in groups could be regarded as "distrustful". They were suspicious of other students who interacted freely to learn from each other, and saw this as dishonesty. For example, NF7HA1 (high achiever) said "we should work individually because people who are not good at mathematics copy and get all the answers and FF7AB16 (average achiever) said "we should work alone so that we write down our own thinking as your friends might give you the wrong answer to copy down". Teachers need to be careful not to interpret students' preference to work alone or their reluctance to approach and ask questions from their peers as lack of interest or uncooperativeness. They need to accept their students' viewpoints and feelings, and at the same time help them to appreciate the benefits of group work. As a minority group in the mainstream schools, students

working in a group may build their confidence by helping each other to learn and working interdependently rather than depending on the teacher.

Group work is one of the many teaching approaches available to mathematics teachers but they should also be aware that Pasifika students, even though they have been brought up in a culture that emphasizes the group over the individual, do not necessarily know how to work together. Pasifika students should be encouraged to work in groups, they need social interaction to learn mathematics effectively and to learn to discuss and share their ideas within their small groups which may make them feel more comfortable about communicating their thinking to their peers to enhance their performance in mathematics.

5.3 Importance of knowing and sharing solution strategies with others

The value of knowing about others' strategies is also important in mathematics learning. The findings of this study showed that of the forty-eight interviewees, nearly seven tenths of Fiji students and just under half of the NZ students stated that it was important to know other students' strategies (see Table 4). The large number of Fiji students who supported the importance of knowing others' strategies may indicate the value of working in small groups in which they depend on their peers for their learning rather than the teacher. Most Fiji classrooms that are in urban and semi-urban centers cater for about 35 to 45 students per class, making it difficult for the teacher to cater for students individually. This finding may be explained by cultural factors as traditional obligations for the Fijians are met in groups in which they share their responsibilities without questioning how much one has contributed as a sign of caring for each other. The impact of the national examination is that they work together with their friends, with some friends taking the role of teachers teaching others and helping each other as a norm to achieve a pass could also contribute to the students valuing others strategies.

It was rather sad to note that fewer NZ students thought that it was important to know others' solution strategies. This is in contrast to the NDP emphasizing discussion as an important tool for both learning and assessment of mathematics, encouraging children to listen to each others' ideas and explain and justify their own. Thomas and Ward

(2002) explained that the key to effective teaching is to ask students to explain their thinking and giving them time to do so, and asking questions and using student's explanations to enhance their thinking. Yackel and Cobb (1996) pointed out that, mathematics education reforms have called for mathematics to be more public activity, with learners communicating openly about their solution strategies. However the perception of Pasifika students in this study suggest that this may not be easily achieved, thus sending out a message that, this may be easier said than done (J. Young-Loveridge, 2005). The finding may also suggest that although the NZ schools understudy had been part of the NDP, changes of teachers may have meant that the school was no longer working that way.

The Fiji and NZ students seemed to hold different views about whether knowing how other people get their answers was important. Three tenths of the Fiji students and half of the NZ students thought that knowing others' strategies was not important. The reasons given by these students were similar to those reasons given by the students who supported the idea of working individually. The mentioning of dishonesty/cheating as one of the reasons should not be taken lightly by the teachers as this could contribute to students' negative attitudes towards interacting with others. As Fiji students' were highly focused on examinations, talking to others might be viewed as cheating and this fact could also explain their reluctance to know others' strategies. Talking to others is seen as inappropriate in other contexts like in formal assessment situations so students may be receiving conflicting messages (Young-Loveridge, Taylor, & Hawera, 2005).

Students need to be taught the importance of interaction with their peers and learning with them. Pasifika students should be encouraged to know others' strategies as it gives them the opportunities to see the many ways in which problems might be solved. Talking to others should not be seen as cheating as listening to another viewpoint could be beneficial in the students mathematics learning. The ideas of others may not be similar to theirs while explaining and justifying their solutions is important in mathematics learning. Maverech (1999) states that children learn through opportunities to explain, justify and listening to others' ideas.

The students in this study are in mathematics classrooms that had been advocating changes in the teaching and learning of mathematics which included reform in communication. Knowing and sharing solution strategies are in the context of strategy reporting community as argued by Hunter (2005). This finding highlights the difficulty faced by the Pasifika students as they interact in a multicultural or mainstream classroom. Boaler (2003) mentioned that within classroom discourse communities, the teacher's role is structured to socialize students into the mathematical discourse community. Hunter (2005) in her study of reforming communication in the classroom found that by the end of the year students had started using enquiry and explaining their thinking in the classroom building up to argumentative discourse.

From the students responses it seemed that they were willing to give and share their strategies when asked, but were reluctant to approach and ask others about their ideas. This behavior seems to be related to cultural factors, as the instructions they receive at home are to listen and respect others, especially those in authority, and not to question what is being delivered even if they do not agree with it. Whether or not the teacher is of Pasifika heritage, does not have an impact on the children as any teacher symbolizes authority to them. The findings also highlight the difficulties faced by the NZ teachers in understanding Pasifika children's culture, interpreting their behavior and in trying to change their ideas about leaning mathematics.

The two groups of participants were almost unanimous in their view that explaining their strategies to others was important. Many of the students who said that it was important to know and share solution strategies indicated that they greatly valued helping, learning and teaching each other, thus highlighting the importance of interdependence for Pasifika students. For Fiji and Pasifika students, explaining ones' strategies to others may work well in small groups with more able students helping the less able ones. Both Piaget and Vygotsky saw cooperative learning with more able peers and instructors as resulting in cognitive development and intellectual growth (Johnson *et al.*, 1998) Some of the Fiji students' responses on their reasons for knowing others' strategies reflected a concern about the correctness of their answers, checking their answers or seeing that they have the same answer with their friends. This is not surprising as the focus on mathematics learning in Fiji is the external examinations where

a right answer is very important to get marks especially when nearly half of the questions are multiple choices. On the other hand, the NZ students had referred to having alternative strategies as the reasons for knowing other's strategies. The NDP has a major focus on the teaching of mathematical strategies rather than focusing on the teaching of mathematical knowledge. Lessons are structured with a key emphasis on strategies and according to Higgins (2001), the NDP had illustrated a shift in teachers' emphasis on the teaching of knowledge to that of strategies as a critical factor.

The critical aspect that knowing others' strategies was important was that half of the NZ students who thought knowing others' strategies were not important gave reasons emphasizing the importance of individuality. To these students it seemed that producing an individual piece of work may lift their self esteem that they know how to do it so that they could inform the others in their mainstream classrooms of their capability. It also gave them a sense of superiority and that they are responsible for their own learning. As NM8HB3 (high achiever) said, "It is really just me, about me and not them". This finding too is consistent with Young-Loveridge's (2005) finding that the responses of most children in the interviews indicated that they continued to regard mathematics from an individualistic perspective as being a private activity that was of little or no concern to others in their class.

One of the key competencies (Ministry of Education, 2007) is about relating to others where students interact effectively with a diverse range of people in different contexts. Students will also have the ability listen to others, appreciate different opinions, justify and share their ideas. Teachers need to encourage Pasifika students to communicate mathematically with their peers and encourage them to relate to others to enhance their learning of mathematics. Teachers must also realize that individuality may result in limited strategies if one cannot appreciate that there are other ways.

5.4 Views about the nature of mathematics

In order to try to understand the students' perceptions of learning mathematics, questions were asked about what they thought mathematics was all about. Aspects of mathematical content were consistently mentioned and many students referred to the Number as being what mathematics is all about. Nearly four tenths of the Fiji students

and two thirds of NZ students referred explicitly to the idea that mathematics is about numbers. Eight Fiji students (8/36) and only two NZ students (2/12) commented on operations on what they thought mathematics was all about. This is consistent with Young-Loveridge *et al* (2006) finding that many students who offered ideas about the nature of mathematics referred to the aspects of the number domain and (Grootenboer, 2003) finding that children's views about mathematics tended to revolve about the number concepts and arithmetic.

It was interesting to note that nearly half of the Fiji students but only two NZ students, referred to mathematical processes such as problem solving as part of the nature of mathematics. This result might reveal the difference between the Fiji and NZ teachers when planning or organizing their mathematics classroom instruction. The NZ teachers may have planned in such a way that all mathematical processes are involved. The *Mathematics in the NZ Curriculum* (Ministry of Education, 1992) emphasized mathematical processes such as problem solving, developing logic and reasoning, and communicating mathematical ideas as one of its main components, while the Fiji teachers just concentrated on solving problems by giving large amounts of various exercises and drills. The Fiji Year 7 and 8 curriculum which is also mainly focused on formal exams encourages teachers to create an environment in their classrooms that gives the students a lot of opportunities to solve tasks by giving exercises from the textbook as a daily routine in preparation for the examinations. This experience had given these Fiji students a view that mathematics learning is mainly about "solving problems". It seemed that the Fiji students may not be solving problems really, but just practicing procedures and algorithms.

A few students (ie. 7/36 Fiji & 3/12 NZ) responses on the nature of mathematics reflected the general cognitive process such as learning and thinking together with developing strategies and knowledge. This may reflect the limited emphasis on these important processes by the teachers of mathematics which may have an impact on how students see mathematics. The curriculum documents of both countries place greater emphasis on mathematical processes (NZ Ministry of Education, 1992; Fiji Ministry of Education Mathematics Prescription, 1997) thus teachers should be aware of its effect on the mathematical development of students.

Only two Fiji students commented on the usefulness of mathematics everyday and another seven (ie. 6/36 and 1/12 NZ) students talked about the usefulness of mathematics for their future. This is in contrast to Young-Loveridge *et al*, (2006) findings that a large number of students that they interviewed talked about the usefulness of mathematics and how useful mathematics is for their futures. Not mentioning the usefulness of mathematics everyday is rather surprising as one of the aims of the Fiji mathematics course is to “develop the pupil’s ability to connect mathematics to everyday situations and also to recognize and appreciate the mathematics in everyday situations” (Fiji Ministry of Education, 1997, p.2).

The New Zealand mathematics curriculum document also emphasized that “mathematics education aims to develop in students the skills, concepts, understandings, and attitudes which will enable them to cope confidently with the mathematics of everyday life” (NZ Ministry of Education, 1992, p.8). Connecting mathematics to everyday learning makes sense to the learners who will then find it useful, meaningful and interesting as students perceptions of mathematics will reflect on where students had related their experiences to. If children’s views about the nature of mathematics are reflected in how they learn in school then greater emphasis should be placed in the learning process.

Only one NZ student (rated as a low achiever by the teacher) out of the 48 participants saw mathematics as being about fun. Researchers like Holton (1993) reports about the pleasure people get from exploring mathematics. Young-Loveridge *et al* (2005) also reported that only the younger students described mathematics as an enjoyable pursuit and that there seems to be an age-related decline in students’ enjoyment of mathematics. Only two students from Fiji did not seem to have a view about the nature of mathematics despite being in the school system for more than seven years. Students need numeracy skills in order to use mathematics effectively in their daily lives and therefore should have an idea about what mathematics is. Teachers should be encouraged to contextualize mathematics so that it is connected to students’ daily lives to make learning more interesting and enjoyable. This is to enable them to make sense of mathematics both in the school and at home or in the community. Given that most of the participants linked their views of mathematics with their experiences of learning

mathematics at school, teachers should consider the messages they send inadvertently, as the way they themselves view the nature of mathematics will have an impact on their practice. Connecting school mathematics and everyday mathematics could either be helped or hindered by beliefs about the nature of mathematics (Presmeg, 2002). The participants' views of mathematics were firmly grounded in their school experiences from which they made their judgments.

5.5 People who support mathematics learning

The students' views about a teacher's role in helping them learn mathematics greatly differed between the two countries. Slightly more than half of the Fiji students (19/36) mentioned that the role of teachers was to show them the solution strategies whereas none of the NZ students made reference to it. This finding might suggest that the Fiji teachers wanted students to listen carefully as they explained their preferred way to solve the types of problems and then let the students work independently or with peers to practice the teacher's method until it was mastered. To the Fiji students, the teacher's role was to direct them on what to do and they were expected to follow exactly as they were told; deviating from that would not be the "right way" to get a solution. They thought that to do well in mathematics they had to listen to the teacher, memorize important procedures and write in their note books so that they could not forget it. Teachers showing students strategies do not make the children think thus producing passive learners. In mathematics learning, students should be encouraged to construct personally meaningful understandings of mathematical concepts by solving problems that challenge them and that could be solved using different strategies which they figured out themselves. According to Williams and Baxter (1996) students are expected to contribute actively to the understanding in the classroom because the teacher is no longer the only source of knowledge.

The responses of the participants also highlighted a very procedural emphasis in mathematics teaching in Fiji. The students' responses suggested adopting the teachers selected method which could be also seen in the textbook provided by the Curriculum Development Unit (CDU) as the "right method". For example FF7AB13 (average achiever) said "the teacher keeps on repeating the method on how to do it so that we

could understand” and FM8HB4 (high achiever) said “The teacher will tell us to copy down the examples that are in the textbook and then give us work to do from that textbook”. This teaching approach does not encourage the children to think or to actively engage in mathematics learning. Kamii and Dominic (1998) explained that algorithms are harmful because they encourage children to give up their own thinking and they “unteach” place value, making it hard for children to understand number sense. The Fiji children’s approach of carrying out of a teacher’s method is consistent with traditional notions of didactic teaching. Many teachers have had extensive experience with this type of instruction (Fraivillig, Murphy, & Fuson, 1999).

In contrast to the Fiji students mentioning the role of teachers as showing them strategies, the NZ students have to figure out strategies themselves instead of being told and thus building their own understanding of mathematical concepts. As Fraivillig (1999) has pointed out, developing of children’s conceptual understanding of mathematics requires teacher knowledge about both mathematics teaching and children’s mathematical thinking. It seemed that the Fiji teachers are comfortable with showing students examples of how to work out a problem, particularly when the solution method is teacher-selected. This teaching approach may produce passive students who view the teacher as the “transmitter of knowledge”. This finding is consistent with Taylor *et al* (2005) finding that a large group of NZ students (~45%) depended much on the teacher and tended to adopt a passive role in their learning. The effect of the national examinations in Fiji could be another factor for these Year 7 and 8 students, as marks are allocated for the step-by-step manner in which their solution method is outlined. This examination driven system also influence the teacher who is rated by the school and parents on how well students achieve in mathematics. Thus getting the maximum marks is seen as more important than understanding mathematical concepts.

It was interesting to find out that slightly more than one-quarter of the Fiji students and half of the NZ students talked about their teacher’s behavior. The students’ comments also highlighted a major contrast between the behavior of Fiji and NZ teachers as perceived by the students. The Fiji students described their teacher as someone who gave them notes to copy, and the textbook as an important resource material. Giving children information to copy fits with a “transmission oriented kind of practice” which is

detrimental to understanding and making sense of mathematics and should be discouraged. Children should be active participants, engaging in meaningful activities where they learn mathematics in rich contexts. The NZ students mentioned their teacher as someone who helped their mathematics learning by sharing clues, giving tasks that challenged them, and grouping them by ability in mathematics before helping them.

In responding to the question about whether or not they were helped by others in their mathematics learning, nearly all of the students (ie. 32/36 Fiji & all 12 NZ) expressed affirmative responses “yes”. They mentioned that their friends/peers in school helped them with their mathematics learning. This finding was very encouraging because evidence has shown that to do well in mathematics students need to listen to their peers as well as their teachers, be able to explain their thinking to others and build upon their own understanding of mathematical concepts (Trafton & Bloom, 1990; Young-Loveridge, Taylor, & Hawera, 2005; Young-Loveridge, Taylor, Hawera, & Sharma, 2006). The perceptions of the NZ students had also indicated the substantial impact of the Numeracy Project on students’ mathematical learning.

The responses of the four Fiji students who said they were not helped by others should not be taken for granted, as not asking questions when they needed help could continue when they proceed in school from grade to grade. These four students were also categorized with the students who mentioned that their teacher helped them by showing strategies in the previous section. It may be that these students might have preferred to seek help from the teacher rather than from their peers, as the Fiji teachers were more likely to have shown them strategies rather than encouraging the students to figure it out themselves. Studies have shown that elementary students who are dependent on the teacher are also relatively likely to seek assistance (Newman & Goldin, 1990). These students seem to prefer the teacher to classmates as “helpers” and sought help when needed assistance which is consistent with Taylor *et al* (2005) findings. One of these students (ie. FM8HA3, high achiever), was mentioned by FM8AA8 (average achiever) as always showing her different strategies for solving a problem. He should be encouraged to share his mathematical reasoning with others, and advised that listening to his peers would greatly help him with his own understanding of mathematical concepts.

The participants' views on how they were helped by others greatly differed for the two countries. Slightly more than half of the Fiji students but only a quarter of NZ students (see Table 8) commented that their friends helped them by showing them a strategy or a way to do mathematics. It seemed that the Fiji students were passive recipients of the teachers' or others' knowledge. The responses of these students suggest that there should be an urgent review of the mathematics curriculum in Fiji with more emphasis on improving the professional capabilities of teachers as the views of these children are embedded on how they learn mathematics daily. It is common knowledge among teachers that these children will have a negative attitude towards mathematics; they will disappear along the way as they move up from grade to grade, and hate mathematics as doing lots of examples and exercises is uninteresting.

Researchers like Lampert and Cobb (2003) argued that mathematics education reforms was about encouraging children to view learning as a social activity in which students interact and learn from peers, teachers and the wider community. Other types of help from others described by the participants included the idea that friends are people who help when the teacher is not there, someone who they can work with, sharing each other's ideas, providing tasks, sharing clues. I was particularly interested in the Fiji student who mentioned friends as peers who provide them written work to copy which was also similar to comments by four Fiji students on the types of help given by their teacher. As mentioned before, giving children information to copy or just transmitting knowledge and not providing rich learning contexts that children engage in their own learning will be detrimental to their progress.

Evidence shows that parents who are involved in their children's education contribute not only to higher academic achievement, but also to positive behaviors' and emotional development (Booth & Dunn, 1996). It was evident in the findings of this research that children thought that their parents play an important role in helping them learn mathematics which is consistent with Hawera, Taylor *et al* (2007) findings. Almost all of the participants except four students (ie. 2/36 Fiji & 2/12 NZ) mentioned the tremendous support given by their parents and relatives to help in their learning. Also a key aspect of the NDP strategy and the NZ Curriculum (see NZ Ministry of Education, 2001, 2007) both emphasizes the strengthening of links with the community. The

students also described various types of how people at home assisted them in their mathematics learning. Their responses indicated that they were assisted at home in informal and in school-directed learning activities by parents and relatives who show them how to work it out when they don't know, giving them tasks to solve and teaching them, helping with their homework and helping them to get better at mathematics.

The responses of the four students who were not helped should not be taken lightly as this reflected the ignorance of their parents on their roles towards their children's learning. In trying to improve students' learning, educators need to build bridges to parents in providing a solid education for all students (Price, 1997). As the children's first educators, childrens' attitudes towards learning, mathematics and study are formed by the parents within the context of the home (Merttens, 1999). An important point to note is that the method of teaching at home should be consistent with that of the classroom if children are to develop to their maximum potential (Merttens 1999; Peressini 1998). However, parents are encouraged to praise their children if they have a strategy that works and if theirs is different that's quite OK (www.nzmaths.co.nz). Evidence has shown that active learning of mathematic concepts may occur if the learning material is connected to the knowledge of the student (Baroody & Ginsburg, 1990). The partnership between school and home should be encouraged and it is also an important link. Parents who wish to support their children in schools may need exposure to recent developments in order to work with teachers and children to raise mathematics achievement (Atkinson, 1999).

5.6 Feelings towards mathematics

It was interesting to note that none of the students chose the sad face. Nearly the same number of students from the two countries chose the neutral face as matching how they felt about mathematics most of the time. They said that they were happy when mathematics was easy or when they knew how to solve the problem. They felt sad when there were too many problems to solve or when they did not understand the given problem. This result is consistent with the NEMP Mathematics Assessment Results 2005, which reported that 49% of the students referred to "about the same" when

responding to the question on how much they like doing mathematics in school (Flockton, Crooks, Smith, & Smith, 2006).

5.7 Perception of self as good at mathematics

Interesting information emerged from the findings about the children's self assessments in mathematics between the two countries. Nearly all of the Fiji students rated themselves according to whether they were *very good*, *good*, *average*, *poor* or *very poor* using their internal practice examination scores. Only a few used information based on getting the right answers to textbook exercises or short tests. They seemed to understand that scoring above 90% was judged as very good, 80% as good, and average child would be scoring between the 60's and 70's and under 20-30% as poor. This is not surprising but rather sad as they revealed the current situation in Fiji. The curriculum is overcrowded with factual content (Coxon, 2000) and has remained largely examination-driven and prescriptive in nature (Sharma, 2000). These Fiji children experience from a young age the learning of mathematics in an exam-driven curriculum where students are judged by examination marks. Success to them is not about engaging in mathematics to understand concepts but rather about the step-by-step method to do a particular type of question which they practice until it is so automatic that they achieve good marks.

It is common knowledge that this examination culture makes Year 7 and 8 teachers in Fiji spend extra hours after school covering the content of the curriculum to prepare the students for their examination. Nisbet (1994) states that teachers "work to the reality imposed by assessment rather than to the rhetoric of a statement of intent" (p. 165). They are forced to change their style of teaching and teach mathematics as it is presented in the textbook for students are only interested in passing their examinations. Not only teachers are pressured but the students too and with the expectations of their parents and the school, students resort to all opportunities that are available to them to do well like paying teachers for extra tuition, or even to the extent of some form of dishonesty.

The Fiji Times highlighted that examinations in Fiji have allowed children to engage in corrupt dealings. According to Lal (2007), leakage of external examination papers is nothing new. Some children go to the extent of obtaining exam papers in exchange for money. These children then make money from it by selling the papers to friends at a

higher cost to help them to pass and also to make a profit. They may be learning to conduct business but this business is rather ridiculous (Lal, 2007). However, the Fiji Ministry of Education does not tolerate leakage of examination papers as there has been prosecution for doing so and children involved failing the paper. This should not be taken lightly by all the stakeholders in the education system in Fiji, for what then are the real functions of examinations. The public should be educated that examination results are not always a true reflection of the student's abilities and skills and must not be used to promote the academic image of the schools that they attend. Some schools also publicize examination results to try and attract high ability students thus discriminating against low ability students.

In contrast to the Fiji students who rated themselves in their mathematics learning using exam scores, the NZ students rated themselves in mathematics on how their teacher grouped them in mathematics. They mentioned that they knew that they were good because they were in the high group, or average because they were in the second or middle group, or poor at mathematics because they were in the low group. This practice is harming low ability students, as Young-Loveridge (2005) explained that students who get most from ability grouping are the higher achieving students. *NDP Book3 Getting Started* (Ministry of Education, 2007) emphasizes that ability groups allow students to work on problems that tightly match the next progression in their learning trajectory but exclusive use of ability students can limit students' expectations of themselves.

Pasifika students who are low achievers in mathematics may find this type of grouping humiliating and will be reluctant to engage in any activity for fear of being exposed of their weakness. In addition, evidence had shown that Pasifika children are under-achieving in mathematics so most or practically all of them will be in the low group. Negative labelling may make the children feeling stigmatised, de-motivated and also they will not be exposed to the more sophisticated thinking of more able students. However, there will be tension between culture of school and own community's cultural ways. Pasifika children were nurtured in their learning and way of life through the process of socialisation where there is hardly competition and only co-operation. Ability grouping does not fit with the cultural ways they are used to.

5.8 Students' responses to the tasks

The three tasks which the students attempted revealed that there was a major difference between the two countries in the strategies used by the students to solve the problems. This is not surprising as this difference reflected the present mathematics curriculum in the two countries. It also revealed differences that exist in how the teachers in Fiji and in NZ operate. The Fiji students were highly committed to the algorithmic approach and showed a high level of procedural fluency. They responded by imagining the written algorithm or wrote the algorithm to show their solution strategy. However, being able to do the written algorithm correct and fast does not necessarily mean that the students understand it.

The NZ students hardly used the algorithmic approach but instead their responses showed the use of mental strategies for solving tasks ranging from stage 2, (counting from one with materials) to stage 7, (advanced multiplicative part-whole strategy). For example “trebling and thirding” at stage 7, which requires one or more numbers that are involved in the division task to be partitioned, manipulated and recombined (refer to <http://www.nzmaths.co.nz/numeracy/2005numPDFs/NumBk1.pdf>) when solving the task. The use of mental strategies by the NZ children clearly showed the success of the NDP as students figure out which strategy to use and explained their strategy when interviewed. Understanding about the relationship between strategy and knowledge are both important in developing number sense. As strategy involves thinking, knowledge is those things that a student can instantly recall in order to think and these are both evident in the student's responses. The findings also revealed the practice of their teachers and the success of the professional development initiative.

Of the three tasks, the subtraction task (37-9) appeared to be the easiest and all the students attempted it. The Fiji students showed a high level of procedural fluency regardless of whether they imagined the algorithm or wrote it. However, some of those who wrote the algorithm struggled to subtract 9 from 17 (ie. When they had crossed off 3 tens, wrote 2 on top of it and then wrote the number 1 beside 7 to make it 17-9). It seemed that they had been taught to follow that method and that there was no alternative strategy. This is rather sad because it reflects the influence of the teacher

selected or textbook method and that they had a routine to follow. The students had been used to written algorithms which is detrimental to their understanding of number sense and mental computation.

In contrast, the NZ students used a range of strategies like “bridging through ten” and “standard place value partitioning”. Two NZ Pasifika students (rated as low achievers) used a version of concrete materials by drawing counting sticks. This is a reflection of the teaching strategy that they experience in their classrooms when they are introduced concrete material first before imaging. This is rather sad as in Year 7, they are at risk as this is not the expected level they should be rated in. The problem of the algorithmic approach was also revealed by two of the four Fiji students who gave incorrect responses and that was the assumption whether the one ten that was borrowed from the three tens will make two tens left or one ten (FF8HA4, high achiever) and subtracting 9 from 17 and the answer as 6 (FF7AB13, average achiever).

There was a general feeling of dislike seen when all the participants were given the fraction task. Half of the NZ students and 6 Fiji students were reluctant to attempt it for they said that fraction tasks were always difficult to them and requested to skip the question. It seems that they were having difficulty in learning fractions and this should not be taken lightly by teachers as they could make this a habit from grade to grade avoiding learning fractions. Evidence has shown that the difficulties students experience with fractions can cause problems with other domains in mathematics such as algebra, measurement, and ratio and proportional concepts (Lamon, 2007). Half of the students who attempted the task and solved it correctly were from Fiji. It seemed they had been developing strong procedural knowledge rather than conceptual understanding because their verbal and written explanations reflected a high level of procedural understanding (for example, “ 6 over 8 and added to 7 over 8 and that is 13 over 8 changed into a mixed number, divided 13 by 8). This links well with Lamon (2007) highlighting that research with students who have had at least five years of traditional instruction in mathematics shows that reasoning strategies tend to be replaced by rules and algorithms by the time students have been at school this long.

Another Fiji student (FM7AB16, average achiever) showed procedural understanding by explaining that $\frac{3}{4}$ multiply by $\frac{2}{2}$ is the same as $\frac{3}{4} + \frac{3}{4}$ which is a misconception because the answer will be $\frac{6}{4}$ and not $\frac{6}{8}$ and she had written down. Teachers should be aware that this potential misconception will not be removed easily from the children because they are used to it and one in which they may develop. Only one Fiji student (FM8HB1, high achiever) appeared to have a deep understanding of fractions. He drew the pizzas and then added the quarter pieces as 3 quarters plus $3\frac{1}{2}$ quarters equals $6\frac{1}{2}$ quarters. He was aware of the equivalence of $\frac{1}{2}$ and $\frac{2}{4}$. It had also been argued that the idea of fraction equivalence is a key component of the part-whole sub-construct for fractions (Behr, Lesh, Post, & Silver, 1983).

One-quarter of the students gave an incorrect answer, and seven of them added the numerators and/or denominators, an error referred to as the “add across” error (Smith, 2002). The fact that the answer many students gave was less than one indicates that they were not thinking about the size of the individual fractions and the likely impact on the combination of the two fractions (Young-Loveridge, Taylor, Hawera, & Sharma, 2006). It should be obvious that correct answer would be greater than one as the fractions were so close to one (Reys, Kim, & Bay, 1999). Another fact that was also evident was that the students fail to realise that they were adding two unlike pieces. For example, you can not add together two coconuts and three fishes to find the total as the two items are totally different. The other five students (all from Fiji with 3 average and two low achievers) whose answers were also judged to be incorrect multiplied the two pieces which indicated the problems faced by second language learners learning mathematics in English which could be referred to as an “English” language problem rather than a “Maths” problem.

It was also sad to note that with the division problem, one-quarter of the NZ students asked to skip the question while almost all of the Fiji students attempted it. Twenty-seven Fiji students and five NZ students’ answers were judged to be correct. However, there was a major contrast between the two countries in the particular ways in which the participants responded to the question. It was evident that the Fiji students had no other alternative strategies to solve problems but only the algorithmic approach. They showed a lot of fluency and a good understanding of the procedure required to get to the

solution. Only two of them (FM7LB21 & FF7LB23) who were rated as low achievers created materials as they drew 81 balls, circled the balls in groups of three and counted the groups. This might reflect the effect of introducing algorithms too early or the over emphasis of written algorithms as the students had faith in using the standard algorithm and could not explore beyond their comfort zone or take risks. The low achievers with their low levels of confidence in their abilities resorted to using concrete materials and never let go of the counting strategies.

In addition, it is rather unfortunate that the Fiji students have become entangled in a vicious cycle as they gripped firmly to standard algorithms. They had been mentioning about the teacher showing them strategies or the “*right way*” to solve a problem and if standard algorithm is the “*teacher selected method*” then it is rather unfortunate to see that they had a limited collection of strategies. It seemed that this may be one of the reasons that the Fiji students are not achieving in mathematics in the secondary level or tertiary level as they are bored with memorizing rules and procedures ever since they came into contact with formal education in Year 1. They cannot think mathematically as it has been drummed out of them. The Fiji teachers should let the students explore, figure out their own strategies and let them take risks to make mathematics learning more enjoyable and elevate their confidence level. Being able to do the written algorithm or do the operations quickly and effectively does not necessarily mean that the students understand mathematics when it is far from it.

Almost all of the NZ students’ strategies for solving the division task showed that they were at Stage 7: Advanced Multiplicative Part-Whole for they used a range of part-whole strategies. It showed that they had developed well along the stages as they were high and average achievers. It was also interesting to note the solution strategies of those whose answers were judged to be incorrect. The two NZ students said that they just guessed but the answer (31) that they gave indicated that they had tried to divide 81 balls by 3. However, the Fiji students multiplied, added or subtracted the two numbers which is an indication that they did not understand the question which may be due to their limited English.

CHAPTER SIX: Conclusion

6.1 Key Findings

This study, which involved a sample of 36 students from Fiji and 12 Pasifika students living in NZ, answered the research question, *what are the perceptions and attitudes of Fiji and Pasifika students towards their mathematics learning?* The findings highlighted what children themselves think about mathematics learning. The research also found out the importance of listening to children talking about their experiences in mathematics learning which teachers have much to learn from. The perceptions of Fiji and Pasifika students towards their mathematics learning should not be taken lightly by the stakeholders involved in the teaching and learning of mathematics. Fiji and NZ Pasifika students underachievement has been well documented and is a cause for concern especially when the movement of people from the Pacific Island countries to neighboring countries such as NZ and Australia has been increasing lately. Listening to Fiji and Pasifika students' views could lead to teachers gaining a deeper insight on their abilities and how they want to learn. Teachers would also be able to see how they teach mathematics from a different angle. They would also realize the difficulties faced by second language learners learning mathematics in English.

Students' support for learning mathematics individually or collectively differed between the two countries. Nearly all of the Fiji students while just over a half of NZ students supported the idea of learning mathematics collectively. The emphasis on the process of group work in the curriculum documents of both countries (Fiji Mathematics Prescription for Class 7 and 8, 1997, New Zealand Curriculum, 2000) requires a change in the teacher's role. Teachers need to learn new ways of assisting students and providing support throughout the group process. Pasifika students are not native speakers of English and at times their reluctance to actively explore concepts with their peers who are European/Pakeha in whole class or small groups may be due to the language of instruction – in this case English. It seems that, if they have limited knowledge of English, then they will not discuss or explain their strategies well for fear of being humiliated.

It was also revealed that from their responses five patterns of responses were identified. Three patterns were given by the students who wanted to work in groups and were classified as *mutual helpers*, *givers of help* or *recipients of help*. The other two patterns were given by those students who supported the idea of learning mathematics individually and were classified as *individualistic* or *distrustful*. The learning preferences of students identified above can provide teachers with a realistic programme for improving the teaching and learning of mathematics. For example, the students had been learning mathematics in the school setting for almost seven years and they should actively engage in mathematics rather than forming a habit of being recipients of help all the time. Learning mathematics is also a social activity where children need to interact with each other sharing their ideas rather than viewing talking to each other as a form of dishonesty.

Communication of mathematical ideas is an important part of problem-solving, as students need to interpret the initial question, explain the answer in the context of the problem, and justify the method used. Nearly seven tenths of the Fiji students and just under half of NZ students commented that it was important to know other students' strategies. However, all the children were unanimous in their view that explaining their solution strategies to others was important. A cultural factor that exists in all Pacific countries is that children listen to authority, they do not initiate discussion and only speak when they are asked to do so. Teachers need to stress that this behavior needs changing so that Pasifika students will be able to compete with others. They have to leave their culture at home and try to adjust themselves to the culture of the classroom because they are a minority group.

The findings also revealed that nearly all students from both countries thought that mathematics was about numbers. Most of the Fiji students believed the nature of mathematics to be solving problems whereas the NZ students perceived mathematics learning having multiple solutions. Teachers should be aware that the participants in this study linked their views of mathematics with their experiences of learning mathematics at school. Teachers should therefore consider the way they teach mathematics. Students' views of mathematics were firmly grounded in their school experiences from which they made their judgments.

The students' views about a teacher's role in helping them learn mathematics greatly differed between the two countries. The Fiji students thought that their teacher's role was to show them examples of how to work out the problems, providing them with notes to copy and providing exercises from the text book. The NZ children mentioned their teacher as someone who gave them clues, provided tasks that challenged them and grouped them by ability in mathematics before helping them. The views of these Fiji children suggested a learning environment with a "transmission oriented kind of practice" which does not link with international reforms in mathematics encouraging teachers to refrain from these didactic forms of teaching. Not only has the Fiji mathematics curriculum needed reforms, the professional capability of teachers also need upgrading immediately.

Parents, relatives and friends involvement in the children's learning of mathematics is thought to be beneficial. The responses of all students revealed the tremendous support from parents, friends and relatives for their mathematics learning. Pasifika students have been brought up in a culture that values the contributions of members of the extended families by sharing and caring for each other. Educators should be aware of this support and current school policies should be modified to involve parents and relatives. When rating their feelings on a three-point rating scale with *happy*, *sad* and *neutral* face, none of the students chose the *sad* face matching how they felt about mathematics most of the time. Similarly, when assessing themselves on how good they were at mathematics none of them chose the box showing "*very poor*". As children, none of them will underestimate their ability to avoid receiving negative comments from others. Students' feelings towards mathematics also affect their emotional and conceptual development. Teachers should note that students also assess themselves from the experiences they encounter during mathematics learning everyday.

The findings also revealed the differences in how the Fiji and NZ teachers operate. The students were asked to do some tasks on subtraction, division and proportional problems. The Fiji students' responses showed their fluency with standard written algorithm and a high level of procedural fluency. This is a cause for concern for Fiji teachers and it is also a clear reflection of how mathematics is taught in their classrooms daily. Teachers should realize that algorithms do not promote critical thinking which a

vital tool for problem solving. The NZ students hardly used algorithm but their responses showed the use of mental strategies for solving tasks ranging from stage 2 (Counting from one on materials) to stage 7 (Advanced multiplicative part-whole) on the NDP Number Framework. Teachers of Pasifika students should give more attention to the students' learning of mathematics as Year 7 and 8 students should not be relying on counting strategies for solving problems. The use of counting strategies also revealed that they are comfortable in using this method which is an indication that they were still at the early stages of mental computation.

It should not be assumed that newly arrived Pasifika students or those who were born in New Zealand will adapt easily to the local academic culture. Teachers need to explain and discuss with students and their parents the expectations of the NZ education system. One such expectation is the importance which the NZ curriculum places upon communicating mathematical ideas. Finding ways to help Pasifika students adapt and improve on their mathematics learning so that assistance could be provided will require research on both the teachers and students' perceptions towards the different styles of teaching, learning and assessment in mathematics.

This research is also different from other research carried out in NZ on children's views about their mathematics learning such as Young-Loveridge *et al* (2005). It explores the views of the Fiji students in Fiji and Pasifika students living in NZ. The other researchers compared the views of the NZ children in NDP schools or NDP verses non-NDP schools. The Fiji system is totally different from the NZ education system for example; the amount of national examination carried out in Fiji. This investigation has revealed the impact of examinations that has affected what teacher's value and what students value in learning mathematics. The Fiji teachers teaching of mathematics is directly controlled by the examinations. The Fiji students also know the importance of examinations and learn mathematics to of pass exams.

6.2 Reliability and Validity

I have tried to ensure that the interviews were as valid as possible. In the process of interacting with the children, I tended to develop an interpretation or a series of interpretations that help provide a new perspective on the children's thinking. Just as the

child's thought is influenced by the interview, so is the interviewers' (Ginsburg, 1997a). Ethical approval to conduct the survey was granted and the children were interviewed individually in a closed room for their own privacy. Their responses were valued and appreciated. The content of the interviews were valid to the objectives of the study and carried out in an organized structure. Some questions were rephrased and unfamiliar terms were explained. When interviewing ethnic Fijian children from Fiji, some questions were translated in Fijian. Every effort was made sure that the data collected was reliable and valid.

A major strength of this study was the method used to gather data on the students' perceptions and mathematical thinking. The interview questions had also been used in several research on students perspectives (J. Young-Loveridge, 2005; Young-Loveridge & Taylor, 2005). The use of the semi-structured interview questions and the tasks provided the researcher with the opportunity to probe into the students' experiences of mathematics and their mathematical thinking. The interview is a tool to capture multiple views and realities of the participants (Stake, 1995). Using semi-structured interviews for data collection in this research enables the students to develop ideas and speak more widely on the issues raised (Denscobe, 2003). The students' perceptions were interesting, relevant and will be useful to teachers as it highlighted some of the hidden messages that influence their mathematics teaching.

6.3 Limitations

Although the sample of the study was small and there was not a balance on the ability and number of students involved, the richness of the data collected outweighs this disadvantage. Another limitation was that, there was not a balance in gender as there were more males than females participating. It would also be more fruitful to observe these students in their classrooms for the researcher to compare their responses to how they learn mathematics everyday. The use of English in the interview was also a limitation. I found that when asked questions in English, the Fiji students even though they can converse and understand English, could not express themselves well. They expressed themselves well when I asked them in Fijian and the students responding in Fijian.

Another limitation that was also encountered was that the researcher was familiar to the Fiji students. The Fiji students were willing to answer all the questions that were asked of them and this directly links with Cohen, Manion & Morrison (2000) explanations about the students will to please adults as they wanted to say what they thought the researcher had wanted to hear. Lastly my skills as a researcher as I acknowledged that I had no prior training before interviewing the children. I also found it difficult to separate the teacher and the researcher in me as I had been teaching years 7 and 8 for almost 15 years. At times when they were doing the task, I provided clues on how to work out the tasks or give them guidance so that they get the right answer. I acknowledge that it was also problematic that the Pacific Islands students in NZ were aggregated as one rather than focusing on the NZ Fiji students alone. The different islands of the Pacific have their own unique cultures and language. Issues that will arise will be different and not the same for all the islands.

6.4 Implications

This study has provided insights on Fiji and Pasifika students' perceptions of mathematics and the results although small may have implications for Fiji and NZ teachers. The findings provided teacher with a deeper insight into children's different learning needs and how children want to learn mathematics. This can empower teachers on the types of classroom instructions that they need to implement in their mathematics classrooms in order to meet the needs of the children.

NZ teachers should be aware of the leaning needs of Fiji Pasifika children who are learning mathematics in a culture different from theirs. Teachers should be able to find ways to accommodate students in their classrooms so that students learn to their maximum potential. As they learn mathematics and develop new knowledge and skills they are also experiencing feelings about themselves as learners of mathematics. They will also be formulating views and attitudes about mathematics that will enhance their learning. These affective aspects need to be addressed by teachers as they can be a powerful influence on the students as they learn mathematics everyday.

Pacific Island students attending NZ schools are very much a minority in that school. They will easily loose their sense of identity and confidence. There may also be tensions

in terms of contrary expectations with schools and the Pacific communities. Not only language is a barrier but also their culture.

The study also has implications for the Fiji education system. There are ongoing reforms that are donor driven. The examinations have an enormous obstruction to the reforms. It is therefore impossible to set goals and learning for understanding. The mathematics examination papers consisted of multiple choice questions which require the students to recall memorized facts and open-ended questions in which they have to produce an algorithm. The teaching of mathematics is also dictated by the format of this paper. Educators in Fiji should examine the present education system and ask themselves on the kind of citizens they want the country to produce.

It might be interesting to do a further study observing these children as they learn mathematics in their classrooms. Observing the children might throw light on what they think. The observation will also reveal what life in the classroom was like for these children. It is also assumed that what people do and what they say are not always consistent. The study could also be developed by collecting data on the teachers' perceptions towards mathematics teaching.

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APPENDICES

Appendix A: Interview Questions

STUDENT INTERVIEW

(Adapted from Young-Loveridge *et al*, 2005)

INTRODUCTION

I am trying to find out more about how kids learn maths and how teachers can help them. I am especially interested in what kids themselves think about mathematics. Would you be willing to talk to me about what happens when you're learning maths?

I can't write very fast, so it would help me if I could turn on the tape recorder. Then I can concentrate on listening to you without having to write. Is that OK with you?

If there are any questions you want to skip, just let me know.

If you want to stop talking to me, that's fine too.

Everything you say today will be kept completely confidential.

This piece of paper [consent form] says:

I've explained what we are going to do.

You are happy about the tape recorder being on.

You know you can skip a question, or stop talking at any time.

Everything you say will be kept confidential.

Your name will be changed in the report so no one will know it's you.

Is all that OK with you?

Could you please sign your name here to show that you are happy about this?

Possible follow-up probes

Can you tell me (or explain) why you think that?

Can you give me an example?

Tell me about that?

Can you tell me how you would start to do that question?

Start Tape & say: can you say your name into the tape to start?

So, [NAME], can u tell me what you've been studying in mathematics recently? Do you like that topic? Why? Why not?

GROUPS

1. Do you have groups for maths? Which maths group are you in?
2. Why are you in that group?
3. Do you contribute during group work? How much?
4. How does the teacher know whether all students are contributing?
5. Do you think that people should work at maths on their own, or should they work in groups? [*Probe*: small or big?] why?
6. What do you prefer?

EQUIPMENT

1. Do you ever use equipment (like counters) when you're doing maths? How?
2. Is it helpful? Would you like to use equipment in maths?
3. Do you think equipment helps people learn maths? How?
4. Do you ever use your fingers in maths? How? [by 1's or 10's/100's]
5. What about calculators; can you use them when you want to? Do you use them? How? Or Why not? [*Probe*: checking work?]

PAPER & PENCIL

1. What about pencil and paper – are they helpful for maths? How?
2. Do you have a maths book that you write in?
3. What kinds of things do you put in it? Can you show me?
4. What about your working out – where do you do that? [if on some paper : What happens to it when you have finished with it?]
5. What about diagrams or pictures?
6. Is there anything else you would like to put in your maths book?

RESOURCES

1. When you are doing maths, do you ever use;
 - a. Work sheets? [*Probe*: how often? How do you feel?]
 - b. Textbooks? [Name]
 - c. *Figure It Out* books?
 - d. Computers?
 - e. Or play games or do activities? [How often? Do you like it?]

PEOPLE WHO SUPPORT MATHS LEARNING

1. How do you think your teacher helps you learn maths?
2. If you had the choice, what would you like your teacher to help you with in maths?
3. What about other people? Do they help you learn maths? How?
4. Is there anyone at home who helps you learn maths? How?

VIEW AND ATTITUDE

1. What do you think mathematics is all about? (*Probe*: If you were going to tell someone about what maths is, what would you say to them?)
2. Have you always felt like this about maths?
3. When did it change?

MAKING SENSE

1. What happens when the maths you are doing doesn't make sense to you? What do you do then?
2. Does the maths you do usually make sense to you?
3. Do you think maths is supposed to make sense? Why?
4. Can anybody be good at maths? What makes you think that?
5. What about someone who is really bad at maths – could they get to be really good at it? How?

MENTAL STRATEGIES

1. Is it important to work out maths problems in your head? Why?

RIGHT ANSWER

1. Do you think it's important to get the answers right in maths? Why? Or Why not? [If not: Is there anything more important than getting the answers right in maths?]
2. How do you know if you've got the right answer?

SPEED

1. How important is to work out your answers quickly?
2. Are there times when being fast is important?
3. Do you ever have competitions or games in your class where you have to work out the answer quickly? Can you give me an example? [*Probe*: Round the World or Maths Whiz]
4. How do you feel about these?
5. How fast are you at these activities?
6. Is there usually only one way to work out the answer, or can there be several different ways? Can you give me an example?

SOCIAL DIMENSIONS

1. How do you check your answer?
2. Is it important for you to know how other people get their answers? Why?
3. Is it important for you to be able to explain to other people how you worked out your answer? Why?
4. What about being able to explain your thinking to your teacher? Is that important? Why?
5. Do you get a chance to explain your answers to anyone? [teachers/students/parents]
6. Do you think that people should work at maths on their own, or is it OK to work with other people?
7. How do you like to work: on your own or with other people? Why?

A. WRITTEN PROBLEMS

I'm going to show you a problem and ask you to work out an answer. Then I'm going to get you to explain how you worked out your answer and make some notes about it here. Is that OK?

[What were you thinking as you worked out the answer]

1. Anna had \$37 in her wallet. She spent \$9 at the supermarket. How much money did she have left?
2. Sione and Tama buy two pizzas. Sione eats $\frac{3}{4}$ of a pizza while Tama eats $\frac{7}{8}$. How much pizza do they eat altogether?
3. Andre has ordered 81 tennis balls. They are in cans of 3 balls. How many cans should there be?

For each question ask:

- a) Can you think of another way to do that question?
- b) What's the best way for you of working out an answer?

Backup Problem for those who can't do either fractions or division: Here is a

Different problem to work out ($9 + 4 =$).

IMPORTANCE OF MATHS

1. Do you think maths is important? Why?
2. Do you see maths anywhere around you? Anywhere else?
3. Do you do things at home or in other places that might involve maths?
4. When you are out with your mates? Out with Mum or Dad?
5. Do you have learning goals in maths that you are working towards? What are they?
6. How important to know your times tables? Why?

Three point rating scale with happy, neutral, sad faces)

ATTITUDE

1. Which face matches how you feel about maths most of the time? Are you happy, sad or in-between?
2. How come you choose that [SAY: happy, sad or middle] face?
3. Have you always felt like that about maths?
4. Which face matches how you used to feel about maths? [If changed] Why do you think there's been a change?

SELF ASSESSMENT

Very poor	Poor	Average	Good	Very Good

1. How good are you at maths? Which one will you choose from the above box?
2. How do you know that?
3. Have you always been that good at maths?
4. Does the maths you do usually make sense to you?
5. What happens when the maths you are doing doesn't make sense to you? What do you do then?

SCHOOLS ATTENDED

1. How long have you been in this school?
2. Which school were you at before you came here?
3. How long were you there? Any other schools before that?

ETHNICITY

1. Which Island group is your family from?
2. Were you born in New Zealand? What about your parents?
3. Do you speak your home language? What about your parents?
4. What language do you use when you speak to your parents/grandparents?
5. Is knowing your culture important to you?

CONCLUSION

Is there anything more you want to tell me about learning maths?

Thanks for helping me understand what kids think about learning maths.

Appendix B: Letters

B1: Letter to school Principal

1/5 Inverness Avenue,
Hillcrest,
Hamilton

Date:.....

Principal,

.....Intermediate School

Ni sa bula vinaka,

I am a Postgraduate student at the University of Waikato, enrolled in a Master of Education degree in the School of Education. I would like your help in fulfilling the research requirements for a directed study, which forms a significant part of this degree. This study aims to explore the Pasifika students' perceptions of mathematics and their attitudes towards mathematics learning and also find out the effect of their ethnicity on their performance.

For this research I would like to interview 12 participants from your school. Preferably I would like to choose students from the different islands in the Pacific. I would like to give some mathematics problems in order to gather information about the strategies students use to solve subtraction, multiplication and proportional problems. The interview for the students is semi-structured, which will allow for a more informal discussion between us.

I would like to talk to children individually for about 30 minutes; at a time the teacher indicates will be least disruptive to their school-work. Participation will be entirely voluntary. The children may choose not to answer a question, or stop the interview at any time. The interview will be audio-taped with the child's consent. The child's name will not be used in the final research report and everything s/he tells us will remain confidential. The only people to have access to the tape will be my supervisor (Young-Loveridge), and I. I would value your help in arranging for children to interview, if possible in early August. I enclose letters of information and consent forms for parents or caregivers of the children to be interviewed. A separate letter of information for teachers is also enclosed. If you need more clarification on the topic or more information on this research study, please contact me on 02102391569 (mobile) or email me at mskb1@waikato.ac.nz

Yours Sincerely,

Siliva Balenaivalu

B2: Letter to Parents/Caregivers

1/5 Inverness Avenue
Hillcrest,
Hamilton.

Date.....

To the parent/caregiver of

Ni sa bula vinaka,

I am a post graduate student at the University of Waikato, enrolled in a Master of Education degree in the School of Education. I am doing some research to find out about students' perspectives towards learning mathematics as part of the Numeracy Project. I would like to give your child the opportunity to talk about what s/he thinks about mathematics learning this year.

I would like to have a chat with your child. S/he may choose not to answer a question, or stop the interview at any time. The interview will be audio-taped with your child's agreement. Your child's name won't be used in the final report and any other publications.

It would really be appreciated if you would agree to your child taking part. If you are happy about this, please fill in the consent form below and return it to school with your child by If you have any questions or require further information, please feel free to call me on 02102391569 (mobile) or email on mskb1@waikato.ac.nz.

Yours sincerely,

Siliva Balenaivalu.

Parent/Caregiver consent form

Parent/Caregiver Consent

I agree to (child's name) being interviewed. I understand that the interview will be audio-taped with my child's agreement, and that all information will be kept private. I realize that my child's name will not be used in the report or any other publications so that s/he cannot be identified. I understand that my child can skip any question s/he chooses to, or stop the interview at any time.

Signed:

Name:

School:

Date:

B3: Letter to the class Teacher

1/5 Inverness Avenue,
Hillcrest,
Hamilton.

Date:.....

Dear Mathematics Teacher,

Kia ora,

I am a Postgraduate student at the University of Waikato, enrolled in a Master of Education degree in the School of Education. I would like your help in fulfilling the requirements of research for a directed study, which forms a significant part of this degree. This study aims to explore the impact of the Numeracy Project on students and teachers.

For this research I would like to interview 12 participants from your school. That is 12 Fiji/Pasifika students and three teachers. I would also ask the maths teachers from these classes to fill a questionnaire. I would like to give the students some mathematics problems in order to gather information about the strategies they use to solve subtraction, multiplication and proportional problems. The interview for the students is semi-structured, which will allow for a more informal discussion between us. A brief questionnaire on teaching and learning of mathematics is prepared for the teachers which will take around 10 minutes to complete.

I would like to talk to children individually for about 30 minutes; at a time the teacher indicates will be least disruptive to their school-work. Participation will be entirely voluntary. The children may choose not to answer a question, or stop the interview at any time. The interview will be audio-taped with the child's consent. The child's name will not be used in the final research report and everything s/he tells us will remain confidential. The only people to have access to the tape will be my supervisor (Jenny Young-Loveridge), and I. When the research report is complete, I will forward a summary to the staff and parents.

I would value your help in arranging for children to interview, if possible in early-August. I enclose letters of information and consent forms for parents or caregivers of the children to be interviewed. A separate letter of information for Principal is also enclosed. If you need more clarification on the topic or more information on this research study, please contact me on 02102391569 (mobile) or email me at mskb1@waikato.ac.nz

Yours Sincerely,

Siliva Balenaivalu

Student's Consent

It has been explained to me what we are going to do. I am happy for the tape recorder to be turned on. I understand that I can skip a question, or stop talking whenever I want. I know that everything I say will be kept confidential, and that my name will not be used in the report.

Signed:

Name:

School:

Room: Year:

Date of Birth: Age:

Date of Interview:

Gender: Male or Female

Ethnicity: Pasifika: Island group

How long have you been in this school?

What is your last school?

Previous School(s):

Primary SchoolFrom to

THANK YOU

Appendix C

Dean's Office
School of Education
Te Kura Toi Tangata
The University of Waikato
Private Bag 3105
Hamilton, New Zealand

Phone +64 7 838 4500
www.waikato.ac.nz



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

MEMORANDUM

To: Siliva Balenaivalu
Associate Professor Jenny Young-Loveridge

From: Dr Rosemary De Luca (Chairperson)
For School of Education Research Ethics Committee

Date: 14 December 2006

Subject: Research Ethics Application

The School of Education Research Ethics Committee considered your application to extend your directed study to include Fiji children and teachers, commencing March 2007.

I am pleased to advise that this application has received ethical approval.

The Committee wishes you all the best with your research.

A handwritten signature in cursive script, appearing to read 'Rosemary De Luca'.

Dr Rosemary De Luca
Chairperson
School of Education