ATTITUDES AND BELIEFS IN MATHEMATICS EDUCATION:

A COMPARATIVE STUDY

BETWEEN NEW ZEALAND AND INDONESIA

A thesis presented in partial
fulfilment of the requirements for the degree
of Master of Educational Studies (MEd Studs)
in Mathematics Education
at Massey University
New Zealand

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1996

ABSTRACT

This comparative study investigated the differences between New Zealand and Indonesian mathematics students and teachers, in attitudinal and beliefs aspects. Attitudes and beliefs about mathematics education were used as dependent variables; countries and gender were used as independent variables.

A total of 191 Indonesian general secondary school students (92 males and 99 females) from grade II (year 11), 8 mathematics teachers (4 males and 4 females), and 47 New Zealand students (23 males and 24 females) from Form 6 and 7 (year 11 and 12) volunteered for the study. Students and teachers completed a researcher developed questionnaire which measured the attitudinal and beliefs about mathematics learning and teaching.

A t-test procedure was used to compare the means of attitudinal and beliefs aspects. Analysis of the data suggested that:

1. Significant differences between countries existed with regard to students' enjoyment of mathematics, value (perceive usefulness) of mathematics, beliefs about mathematics, mathematics learning, and beliefs about home support.

2. Differences within New Zealand students by gender were due to students' beliefs about mathematics learning and beliefs about mathematics teaching. No significant differences were found within Indonesian students by gender for attitudinal and beliefs aspects.

3. Differences among subgroups gender (males and females for New Zealand and Indonesia) were found in students' value (perceive usefulness) of mathematics, beliefs about

mathematics, beliefs about mathematics learning, and beliefs about mathematics teaching.

4. Differences in teachers' beliefs about learning and teaching mathematics were found. In Indonesian, mathematics teachers emphasized students listening to teacher explanations, note taking, reading text-books, doing written exercises from text-books, watching a teacher work through a problem, working out practical problems, and opportunities for students to practice exam/test questions. New Zealand mathematics teachers emphasized teacher led discussions, demonstrations, and explanations, as well as student discussions.

These findings are restricted to the sample population of grade II (year 11) students at general secondary school Jakarta and Form 6 and 7 (year 11 and 12) coeducational secondary school in Palmerston North. However, it is felt that these schools are representative of schools at the senior level in their respective countries. This study indicates that there are differences in some aspects of attitudinal and beliefs about mathematics, but does not relate these findings to students' performance in mathematics. The effect of attitudinal and beliefs aspects on performance in mathematics, and in relation to curriculum reforms, should be explored in the future research.

ACKNOWLEDGEMENTS

In the name of Allah the most gracious and most merciful. This study will not have been possible without the help of Allah swt.

Acknowledgements and thanks

...to my supervisor Dr. Glenda Anthony, for her encouragement and valuable time spent in reviewing my work, and for her many thoughtful suggestions.

...to all Indonesian and New Zealand students/teachers for their help to participate in this study.

...to Indonesian and New Zealand governments for their financial assistance that made this study possible.

...to my parents and family for their encouragement and moral support.

...and last but not least, to my wife Arfah Yuzmi and my very young wonderful "Kiwi" son Aditya Barulhadi Margono; their prayers, patience, and steadfast encouragement have given me a meaningful life.

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CHAPTER 1

INTRODUCTION

1.1 Mathematics Education in Indonesia

1.1.1 Background

Indonesia is the largest archipelago in the world, straddling the equator over an area more than 5,000 kilometres. It is made up of more than 13,600 islands (6,000 populated) in the South Pacific, and is considered to be part of Southeast Asia. Indonesia's geographical layout explains why its population of more than 190 million can be differentiated into more than 300 ethnic groups speaking more than 250 languages, not including dialects. Indonesia declared its independence in 1945 after 350 years of domination by the Dutch and Japanese occupation during World War II. The road to independence was difficult. Because of the rich, varied, and highly developed culture, and the 350 years experience of being a Dutch colony, there was strong and widespread feelings of national pride and commitment to national development.

The past five consecutive Five-Year-Economic-Development-Programs, starting on April 1 1969, have brought forward this previously undernourished population, barely surviving in a disabled economy, into the forefront of the world's fastest growing nations. Indonesia's Gross National Product has grown by an average of 7.3 percent annually over the last 25 years, increasing its per capita Gross National Product from about US $50 in 1967 to around US$ 919 today (see Republika, 1995). Today Indonesia is one of Asia's powerhouses geared to move ahead into the 21st century. With attempts to achieve modernity and promote industrialization, it has placed a heavy emphasis on science based education and associated mathematics education. However, Linuwih (1993) claims that it is impossible to consider mathematics education in Indonesia without having some awareness of the magnitude of the operation of Indonesian education, its rapid development, and the diversity of the circumstances in which it is applied (p. 173). Indonesia's education problems cannot be freed from the problems associated with social, economic and political changes. Ignorance, under development, poverty, unemployment, a large and fast growing population and other related problems are of central concern.

As a country with a large and diverse population, Indonesia has to determine the choice of educational development priorities for primary, secondary, and tertiary sectors. Functioning under economic restraints educational equity within the nation is impossible; decisions at the national level must be made in the allocation of educational resources including schools, teachers and textbooks. In such a situation, a paramount decision is which particular subpopulation would supply the most attractive returns for the educational investment.

In 1993 the introduction of compulsory education between the ages of 6-15 years reflected the good intention of the government to increase educational quality. Compulsory education is a crucial step in reaching the national goal of developing "the intellectual life of the nation" (in the preamble of the 1945 Constitution). Indonesian schooling is structured into six years of elementary school (grade 1-6), three years of junior high secondary school (grade 7-9), and three years of senior high secondary school (grade 10-12). Mathematics is taught at all levels of schooling, including kindergarten. We use the term SMA (*Sekolah Menengah Atas*) for the general secondary senior school. The general senior secondary schools' curriculum is divided into four programs, namely, Physics (A_1), Biology (A_2), Social Sciences (A_3), and Cultural Subjects (A_4). All four programs contain mathematics. Program A_1 involves more mathematics content than A_2, which involves more mathematics than A_3 and A_4 respectively. To enter into program A_1 or A_2 the students have to fulfil the following conditions (Linuwih, 1993, p. 176):

* The elective Grade Point Average in the first and second semester must be more than or equal to 6 (maximum score is 10).
* The average score in mathematics, physics, biology, and chemistry must be more than or equal to 6.

1.1.2 Mathematics Curriculum

There is a new draft curriculum (1994) which will be implemented in 1996. However, for the purposes of this research study it is noted that the classroom research setting and instruction goals are aligned to the curriculum statement (*Kurikulum Sekolah Umum Tingkat Atas*) developed in 1984 and implemented in 1986. In addition to the curriculum statement the Department of Education and Culture supply study notes which specify not only the nature and level of topics to be covered, but also the number of hours to be spent in each grade on each subject. These are normally revised every 10 years. The curricula in all schools, from primary school to secondary school use Bahasa Indonesia (Indonesian language) without distinguishing ethnic groups which exist in Indonesia.

The mathematics curriculum was modified from the earlier mathematics curriculum (1975) as follows :

* The mathematics material for students from primary school up to high school was organised to be more interrelated at each level.
* It was expected that the differences and overlap between primary and secondary materials would be reduced, or even eliminated.
* The aim was to reduce primary mathematics content without reducing the abilities of primary students. To achieve this,

it was recommended that extra attention and time be given to mental arithmetic exercises aimed at improving the students' skill in arithmetic operations.

* The time allocated in secondary school to revising primary school work was reduced.

(*Departemen Pendidikan dan Kebudayaan*, 1986, p. 3)

The general objectives of the mathematics curriculum (*Departemen Pendidikan dan Kebudayaan*, 1986, p. 2) are as follows:

1. To prepare the student for changes of situation in their life, as well as the changing world, through exercises of thinking logically, rationally, critically, accurately, objectively, creatively and effectively.
2. To prepare the student to be able to use mathematics properly in their everyday life and in studying sciences.

Curriculum descriptions of mathematics include:

(1) a tool which can be used in the various sciences and everyday life;

(2) the thinking patterns of mathematics involve abstraction /idealization/generalization; and

(3) a science which can be developed (p. 2-3).

Suparman (1983) summarises ten characteristics of the present mathematics curriculum as follows: (1) focus on the requirement of general people; (2) focus on the needs and attitudes of students; (3) organization of effective learning; (4) emphasis on mathematical thinking, relationships of concepts and generalization; (5) formulation of a clear and exact teaching programme; (6) emphasis on problem solving; (7) attention to individual student differences (8) open to use of new instructional method; (9) emphasis on the importance of assessment on learning performance; and (10) application of a balanced learning programme.

It is noteworthy, that while focusing on the needs of the people, the curriculum was developed for a **developing industrial society** and reflects little influence of advance technology. The use of calculators is not advocated in the curriculum. New courses referred to in the curriculum include 3-d geometry and introductory computing. However, introductory computing courses emphasise theoretical understandings rather than direct applications. Thus schools which teach computing are not necessarily involved in application and practice of actual computing skills (*Departemen Pendidikan dan Kebudayaan,* 1986). Not too surprisingly, Linuwih (1993) found that most of the primary and secondary school teachers did not agree with the use of calculators by the students: they thought that it would reduce basic competence in the arithmetical operations. Even though Asian countries lead the world in technology, teachers and parents are still wrestling with the conflict between the traditional emphasis on paper-and-pencil algorithms and the new technology (Bell, 1993).

1.1.3 Teaching and Learning

Usually Indonesian mathematics teachers in secondary schools are subject specialists, with an educational background of tertiary education in mathematics and education. The quality of teaching is poor (Linuwih, 1993), and many teachers are forced to supplement incomes by additional employment (Jones, 1994).

In the *Assessment of Indonesian education: A guide in planning* Beeby (1979, p. 78) reported concern about mathematics teaching:

> ...the lesson are lacking in variety, and with a few exceptions, the same standardized pattern of lesson is repeated throughout the school day. The teacher talks and usually puts written notes on the blackboard (this takes up half the average

> lesson); the students listen passively; there is a very short time for questions and answers, and the questions are routine and recapitulatory; the students then record notes from dictation or from the blackboard. Sometimes, where textbooks are in especially short supply, teachers simply begin with dictating notes, and if any time is left at the end give a few explanations.

The description is still valid in most secondary schools throughout Indonesia. It is not usual to teach mathematics using games or activities. There are some teachers who teach neither the applications of mathematics in everyday life nor the activities method (Linuwih, 1993).

Typically students' learning experiences in school mathematics classes leads to an implicit expectation that mathematics concepts and skills are learned from the teacher, or another authority, and then practiced. Resources that might provide additional access routes for learning mathematics (e.g., manipulatives, cooperative problem solving, and genuinely instructive textbooks) are not usually available to students. Another potential resource for mathematics students are their parents or other family members. However, because of educational standards in the past it is unlikely much explicit mathematics instruction is available from home.

To recognise mathematics as a cultural product is also to confirm that it is a human product. As such it exists because people have valued the activities concerned with it. But people value mathematics for different reasons. The teacher might like to teach for the rigorous training of the mind that it is assumed to develop in the young. The student might choose to study mathematics for the enjoyment he or she gets out of exploring abstract ideas. The parent however might think is important for their child to study, so that they can get a good job later on.

We particularly recognise the existence of values of mathematics whenever we attempt to answer the question "Why teach mathematics?". In Indonesia, Swadener and Soedjadi (1988) listed the following reason for teaching mathematics, all of which imply a recognization of values:

(1) Universe: in every mathematical problem it is important to understand the existence of a universe of the problem. The solution to a given mathematical problem will likely be different within a different universe;

(2) Agreement / Conventions: mathematics is replete with agreement about concepts, facts, and operations. Agreements in mathematics depend on the freedom to define mathematical objects as necessary to accomplish desired goals;

(3) Contradiction: contradictory results are not permitted in mathematics. If contradiction is permitted in mathematical structure, the structure collapses and is therefore unproductive;

(4) Transformation: in mathematics there are many formulas which translate one set of conditions in one universe into another set of conditions in another universe. Several transformation formula may be used to change one quantity into another or to translate a relation in one universe into another form in another universe; and

(5) Analogy: in mathematics the teacher can pay special attention to analogies, i.e. similarities between sets of circumstances with respect to both form and procedure.

Mathematics teachers from Indonesian have heavy teaching load (often being required to teach in two local schools) and complain about the disparity between curriculum demands and limited teaching time available. An overloaded curriculum including a full subject of Religion, Pancasila (study of Indonesian ideology), and History, in addition to more traditional areas, and heavy teaching loads, leads to pressure on both students' and teachers' abilities to develop affective teaching and learning approaches.

For the most part, teachers concentrate on exposing weaknesses in students' knowledge, and offer limited helpful explanations - students respond by privatising their thoughts and questions rather than by open discussion and communication. Thus skills developed in a learning environment which encourages risk taking, freedom to make errors and question without fear of recrimination, are not commonplace in Indonesian secondary schools. The implications for students' learning are obvious; learning strategies are aimed at absorbing and remembering as much of the material as possible and recycling this information in exams. To achieve the coverage demanded by the curriculum learning strategies are directed to recall and task completion rather than understanding and knowledge construction.

1.2 Mathematics Education in New Zealand

1.2.1 Background

New Zealand has been inhabited since the tenth century AD when Maori from southwest Polynesia first began to settle in what they called ***Aotearoa*** - The Land of the Long White Cloud. English-speaking settlers from Australia and the United Kingdom began arriving from 1792 and in 1840 New Zealand became a British colony. British institutions and culture have strongly influenced the development of the country's political, social, and education systems. Since about 1960, however, as the Maori population has become larger, more urbanized, and more political, there has been a growing acknowledgement of the importance of Maori culture within New Zealand society. Those New Zealanders who identify as Maori (12% of population) are expressing their aspirations for a future that recognizes their culture, language and values alongside with those of the majority population. During the same period, New Zealand has experienced a new wave of Polynesian migration. Pacific Islanders who have either migrated to New Zealand, or been New Zealand born, now comprise nearly 3% of the population. As New Zealanders recognize their place as a South Pacific nation they are increasingly coming to terms with cultural diversity, with particular reference to Maori and Pacific Island cultural forms.

In comparison with Indonesia, New Zealand is a relatively small nation with a population of some 3.3 million. One-third of all New Zealanders are said to be active, in one way or another, in the national system of education comprising of early childhood, primary, secondary, tertiary or continuing education sectors.

Differentiation of the educational sector in New Zealand education system differs from the Indonesian education system. In New Zealand, schooling is divided into eight years of primary schooling (of which the last two years for most children in urban centres takes place in separate intermediate schools), followed by up to five years secondary schooling. This (6+2)-(3 to 5) division compares with the 6-3-3 year division in Indonesia. Organisational differences are also evident within the senior secondary schools. The average number of students in each class (45 students) in Indonesia (Linuwih, 1993) is considerably greater than would be expected in secondary school classes in New Zealand. In Indonesia mathematics is a compulsory subject from kindergarten to the end of secondary school, but in New Zealand it is compulsory subject until year 10 or 11 (depending on the school).

1.2.2 Mathematics Curriculum

The prominence given to mathematics education is reflected in the *New Zealand Curriculum Framework* (1993) document's specification of eight essential skills: communication, numeracy, information, problem solving, self-management and competitive skills, social and co-operative skills, and work and study skills. These skills are integrated into the seven essential learning areas: language and languages, mathematics, science, technology, social sciences, the art, and health and physical well-being. The framework document promotes active, co-operative and diverse learning situations in which the teacher is seen as a guide, a provider of resources, and as a facilitator. Central values of education explicitly presented within the nine basic principles, include: honesty, reliability, respect for others, respect for the law, tolerance (*rangimarie*), fairness, caring or compassion (*aroha*), non-sexism and non-racism. The curriculum framework also includes a separate section on attitudes and values.

Mathematics in the New Zealand Curriculum (Ministry of Education, 1992, p. 7) views mathematics as a human endeavour; "mathematics involves creativity and imagination in the discovery of patterns of shape and number, the perceiving of relationship, the making of models, the interpretation of data, and the communication of emerging ideas and concepts."

In contrast to the mathematics curriculum in Indonesia the aims of the *Mathematics in the New Zealand Curriculum*, include explicit statements concerning affective issues as well as those concerning skills acquisition:

> help students to develop a belief in the value of mathematics and its usefulness to them, to nurture confidence in their own mathematical ability, to foster a sense of personal achievement, and to encourage a continuing and creative interest in mathematics; ... develop in students the skills, concepts, understandings, and attitudes which will enable them to cope confidently with the mathematics of everyday life (Ministry of Education, 1992, p. 8).

Moreover, the *Mathematics in the New Zealand Curriculum* emphasises the need to cater for individuals in maths, especially women participants:

> In many cases in the past, students have failed to reach their potential because they have not seen the applicability of mathematics to their lives and because they were not encouraged to connect new mathematical concepts and skills to experiences, knowledge, and skills which they already had. This has been particularly true for many girls, and for many Maori students, for whom the contexts in which mathematics was presented were irrelevant and inappropriate. These students have developed deeply entrenched negative attitudes towards mathematics as a result (Ministry of Education, 1992, p.12).

Curriculum suggested learning experiences include setting mathematics in relevant social contexts, assigning co-operative learning tasks, and providing opportunities for extended investigations.

In contrast with Indonesia, technology, especially calculators, is an integral part of the mathematics classroom: "both calculators and computers will be available and used in the teaching and learning of mathematics at all levels." (Ministry of Education, 1992, p. 14).

1.2.3 Teaching and Learning

When one examines current teaching methods there is evidence of contrasts between Indonesian and New Zealand. From a sample of 4 secondary schools, Walshaw (1994, p. 16) provides the following description of mathematics teaching in New Zealand classrooms:

> Teaching mathematics often involved teacher led discussion and teacher explanations, and sometimes involved teacher demonstration, teacher-initiated

> investigations, task, sheets, and media presentations, together with learner-centred activities of small group and class discussion, projects, new challenges, student-worded mathematics, exploration of ideas, pitfalls and misconceptions, consultation with reference sources, and student initiated investigations.

This description reflects curriculum statements concerning teaching.

With regard to mathematics learning, *Mathematics in New Zealand Curriculum* (ministry of Education, 1992) emphasises students as problem solvers and the need to develop students' ability to think mathematically.

> Learning to communicate about and through mathematics is part of learning to become a mathematical problem solver and learning to think mathematically. ...Creativity in problem solving is recognised as one of the basic traits that must be developed if outstanding achievement is to result, and it plays a major role in innovation, invention, and scientific discovery (p. 11).

1.3 The Rationale of Present Study

1.3.1 The Role of Comparative Study

While curriculum contents are relatively similar there is, however, a great deal of variation among different societies and education system. "Different cultures embrace different beliefs, attitudes, and values with respect to education, and with respect to mathematics" (Stigler & Baranes, 1988, p. 260). The universal status and importance of mathematics, the similarity of mathematics curricula worldwide, and the link between the study of mathematics and the development of a nation's economic strength (Walberg, 1983) has encouraged the development of comparative studies in mathematics education.

A comparative study which examines attitudes within and between students from New Zealand and Indonesia may alert us to differing influences from curriculum, instruction, and societal expectations. Findings may enable mathematics educators to benefit from the educational experiences of other countries and help mathematics educators to review their own mathematics education system more objectively. Stigler and Perry (1988, p.199) suggest that cross cultural comparison also leads to "a more explicit understanding of their (one's) own implicit theories about how children learn mathematics. Without comparison, we tend to question our own traditional teaching practices and we may not even be aware of the choices we have made in constructing the educational process."

Most comparative studies emphasise differences of achievement outcomes. The stereotype from previous comparative studies between Asian and Western countries is that Asian students fared well in international comparisons because they are well-drilled in the basic concepts and operations of mathematics, but they lack ability to apply these effectively in problems that do not rely on the routine in which they have been rehearsed (Chen, Lee, & Stevenson, 1993; Stevenson & Stigler, 1992).

Previous comparative studies have also noted differences in teaching and learning styles between Asian and Western countries. For example, Stevenson, Lee and Stigler (1986) found that Asian children spend a great deal more time on schoolwork - in school, at home, and in special after-school programs - than do American children; a process supported by important cultural differences.

Major differences between Japanese and American styles of mathematics teaching have been reported (Stigler & Baranes, 1988). For example, Asian teachers place emphasis on the use of concrete manipulative material, but, unlike American teachers, they tend to use the same manipulatives for many different instructional purposes. Japanese teachers use the objects (manipulatives) as a topic of discussion, whereas American teachers tend to use the objects as a substitute for discussion.

Mathematics teachers in Asia have frequently pointed out problems, such as the narrowness of their curriculum, the orientation toward preparation for entrance examinations, the emphasis on procedures for solving problems but not on understanding of concepts, and the negative consequences in terms of decreased motivation and increased level of stress resulting from high pressures placed on students (Chen, Lee, & Stevenson, 1993).

At present, Indonesian students are subjected to a strict style of teaching which includes the deliberate and authoritative provision of information which is expected to be learnt and repeated in the end-of-year examination. Teachers are respected and not questioned, and students have little opportunity to express affective concerns. The availability of a range resources is limited. This style of teaching contrasts the active encouragement of student discussions, group work, and investigations advocated in the mathematics curriculum in New Zealand.

Holloway *et al.* (1986) reported dramatic differences in mothers' beliefs about the causes of success and failure in school. Mothers were asked to identify sources of success of their children in grade 5 mathematics. In Japan, poor performance was attributed of lack of effort. They were less likely to blame the school, the child's ability, or luck; nor did they see the difficulty of the task as a significant element in the child's level of performance. In United States, mothers cited lack of effort as the most significant factor, but they also cited lack of ability and poor classroom instruction. Generally American mothers assigned more blame to the school for low performance than did Japanese mothers.

Given the differences in mathematics teaching and learning, curriculum aims, classroom environments, cultural practices, and availability of resources, one would expect differences in learning outcomes to be evident between Indonesian and New Zealand mathematics students. Specifically, these differences may reflected in students' attitudes towards mathematics and their beliefs about mathematics and themselves as mathematics learners.

1.3.2 Gender-related Differences

Over the past decade gender-related differences in mathematics achievement and participation has received a great deal of attention. While early explanations for differences included genetic factors (Benbow & Stanley, 1983), more recent studies (Fennema & Leder, 1990; Fennema & Peterson, 1985) have discounted genetic differences in favour of socialization and affective factors.

Students' beliefs about their own performance and long-term expectations are likely to be reflected in, and reinforced by, the values held by members of their peer group. The small, but recurring differences between males and females in personal-belief variables, such as confidence, risk-taking behaviour, motivation and related characteristics, including fear of success, attributional style, learned helplessness, mastery orientation, anxiety, and persistence continue to attract research attention (Burton, 1990; Fennema & Leder, 1990; Leder, 1992b).

1.3.3 Research in Affect

The role of affect in mathematics learning is seen as increasingly important. An important outcome of learning mathematics is the construction of attitudes, beliefs and values (Leder & Gunstone, 1990; McLeod & Adams, 1989; McLeod, 1992). Research on affective issues is currently needed in three specific areas. Firstly, affective issues are now seen to be significant mediators of the development of higher-order thinking skills and nonroutine problem solving (McLeod, 1988, 1992; Schoenfeld, 1992). For example, the research by Silver and Metzger (1989) points out that aesthetic considerations play an important part in the decisions that research mathematicians make in solving nonroutine problems. Secondly, the current emphasis on affective influences related to gender differences needs to be strengthened and expanded. Thirdly, research on affective issues needs to be directed to the study of cultural influences on mathematics learning, linking differences in achievement to beliefs that are connected to cultural influences (McLeod, 1994).

A study of affect will serve to increase knowledge and build theories that describe human behaviour and cognitions. Increased knowledge about affect will assist teachers develop instruction aimed at helping students understand and value mathematics and develop appropriate learning goals and beliefs about mathematics learning.

1.3.4 Research Questions

The major objective of this study is to identify and compare attitudes and beliefs of senior mathematics students from both New Zealand and Indonesia. The nature of the curriculum aims and current teaching practices reflect major differences between Indonesia and New Zealand systems. The assumption is that we can see the solution to our own problems a lot of more clearly if we draw upon the collective wisdom and experiences of others around the world (Mazurek & Winzer, 1994).

Specifically, data will be collected from interviews with

Indonesian students and teachers and attitudinal and belief questionnaires from students of both countries.

The general research questions are as follows:
1. Are there any differences between Indonesia and New Zealand students in the following attitudinal categories:
* enjoyment of mathematics;
* value (perceive usefulness) of mathematics;
and in the following beliefs categories:
* the nature of mathematics;
* themselves as mathematics learners;
* mathematics learning;
* home support in mathematics learning; and
* mathematics teaching; and
* attribution to success and failure in mathematics learning.

2. Do gender differences in affective responses exist between male and female Indonesian students; or male and female New Zealand students?

3. Are there significant differences in affective responses between subgroups gender; male New Zealand, female New Zealand, male Indonesian, and female Indonesian students?

4. Do differences exist between New Zealand and Indonesian mathematics teachers in their beliefs about mathematics learning and mathematics teaching?

1.3.5 Overview of Chapters

Chapter 2 examines the importance of affect in mathematics learning, and the interrelationship between attitudes and beliefs. The role of affect is situated in a theoretical model of learning.

Chapter 3 reviews literature concerning attitudes and beliefs about mathematics and oneself as a mathematics learner, attribution to success and failure in mathematics learning, students' beliefs about home support. Gender-related differences in attitudes and beliefs are also examined.

After outlining the research methodology in chapter 4, the following chapters (5 and 6) present an analysis and discussion of the results.

CHAPTER 2

AFFECTIVE FACTORS IN MATHEMATICS EDUCATION

2.1 Introduction

It is now widely accepted that an understanding of the nature of mathematics learning requires exploration of affective as well as cognitive factors. Early research related to affect focused on feelings, emotions, and moods that arose quickly and spontaneously. Later, educational research was based on the broader concept as defined by the *Taxonomy of Educational Objectives: The Affective Domain* (Krathwohl *et al.*, 1964). In this definition the affective domain includes attitudes, beliefs, appreciations, tastes and preferences, emotions, feelings, and values.

In mathematics education, McLeod (1992) noted that a clear definition of affect and the affective domain has been a persistent problem in understanding the connections between affect and mathematics teaching and learning. McLeod (1989, p. 245) used the term affective domain to refer to a "wide range of feelings and moods that are generally regarded as something different from pure cognition", including beliefs, attitudes, and emotions. These three types of affective reactions are distinct not only with respect to stability, but also with respect to their degree of cognitive loading. Beliefs have a very strong cognitive component; this cognitive loading decreases as one progresses from beliefs to attitudes to emotions.

The influential *Handbook of Research on Mathematics Teaching and Learning* (Grouws, 1992) devotes considerable space to the impact of affective factors, including student and teacher beliefs and attitudes on mathematics learning. This contrasts with the comprehensive *Handbook of Research on Teaching*

(Wittrock, 1986), published less than a decade earlier, which did not explore in any depth the interaction between student or teacher attitudes and school learning.

2.2 Definition of Attitudes

"Attitude is a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (Allport in Kulm, 1980, p. 356). A contemporary summary of views concerning the nature of attitudes is given by Oppenheim (1992), who cites an attitude as: "...a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli". Specifically, one's attitude toward mathematics is defined as a general emotional disposition toward the school subject of mathematics (Haladyna *et al.*, 1983, p. 20). This emotional disposition includes a general psychological dimension of enjoyment of mathematics, which encompasses not only a liking, or not liking, for mathematics problems, but also includes the recognition of the importance or value of mathematics. This research study will focus on attitudes concerning enjoyment of mathematics and value (perceive usefulness) of mathematics.

2.3 Definition of Beliefs

Students' beliefs about mathematics and themselves as learners may affect students and teachers positively or negatively. When students like mathematics and want to do well they are more likely to be intrinsically motivated to do something positive to learn and develop in mathematics. We cannot really see the belief itself, as it is internal to the student, but we can make inferences from one's behaviour and what one says in an analysis of a situation.

Belief is "experience-based, and knowledge-based" (Chiou, 1995, p. 48). It is *experience-based* because it is the accumulation of years of practice. It is *knowledge-based* because it is supported and constrained by domain knowledge. Without enough experience and knowledge, we could not have beliefs about something.

Schoenfeld (1985) refers to beliefs about mathematics as an individual's mathematical world view that is, "the perspective with which one approaches mathematics and mathematics tasks" (p. 45). More recently, Schoenfeld's (1992, p. 358) definition of beliefs about mathematics is "an individual's understanding and feelings that shape the ways that the individual conceptualizes and engages in mathematics behavior." This research study will focus on beliefs about mathematics, oneself as a mathematics learner, mathematics learning and teaching, home support, and attribution to success and failure in mathematics learning.

2.4 Interrelationship between Attitudes and Beliefs

The distinction between beliefs and attitudes is murky at best (Hart, 1989). In an attempt to reduce this murkiness, we need to investigate the relationship between beliefs and attitudes. Are all attitudes also beliefs; if not, then how do we distinguish those that are from those that are not?

In mathematics, beliefs constitute the individual's subjective knowledge about self, mathematics, problem solving, and the topics dealt with in problem statements. The term belief is reserved for the information that a person accepts to be true. These beliefs may have been acquired first hand, or picked up from the comments of other people, and may have positive, negative, or no evaluative implications (emotional attachment) for the study of mathematics.

Beliefs relate to learning behaviour because they contribute to the formation of attitudes. McLeod (1992) suggests that beliefs may be filters through which experiences and events are interpreted by learners. Further, when clusters of beliefs are organized around an object or situation and predisposition to action, this holistic organization becomes an attitude. The one prominent attribute that distinguishes attitudes from beliefs is that attitudes engender a predisposition to respond emotionally; beliefs do not. "Attitudes are reinforced by *beliefs* (the cognitive component) and often attract strong *feeling* (the emotional component) which may lead to particular behavioural *intents* (the action tendency component)" (Oppenheim, 1992, p. 175).

The following (Table 2.1) is a comparison of attitudes and beliefs and how they differ in respect to psychological objects:

Table 2.1 The differences between attitudes and beliefs

Term	Typical Object	Major Component
Attitudes	Things, people, place	Contains affect, cognition, and behaviour
Beliefs	The general acceptance or rejection of basic ideas	More emphasis on cognitive acceptance or rejection

(Adapted from Simpsons, Koballa, Oliver, & Crawley III, 1994)

In light of the interrelationships among beliefs, attitudes, and behaviours (intended or actual), any discussion of attitude must also deal with belief, behaviour, and context. The relationship between beliefs and anxiety is explored in relation to problem solving in mathematics (Carter & Yackel, 1989). For example, if an appropriate rule or solution path is not apparent during a problem-solving situation the learner is at standstill since there is no mechanism in place for modifying and/or developing rules or procedures. This situation may cause feelings of panic, inadequacy, and anxiety. On the other hand, if individuals believe that mathematics is relational, that is, mathematical knowledge is an interconnected, meaningful network, they are not afraid to enter their mathematical network and try to derive or develop an appropriate solution when the solution to a mathematical problem is not immediately apparent. Relational mathematics learners realize that there are many points from which to enter their networks of mathematical knowledge and will thus feel comfortable using their experiences and emerging knowledge during problem-solving.

2.5 The Importance of Affective Factors in Mathematics Education

It is almost universally acknowledged that educational objectives in the affective domain - those dealing with attitudes, beliefs, emotions, moods, interests and values - are of great importance. Feelings of liking (or hating) mathematics, and perceptions of the nature of mathematics, such as a body of rules to be memorized, have been found to be influential both on learning processes (Anthony, 1994a) and on learning outcomes (see McLeod, 1992). The role of affect is particularly important in the development of higher-order thinking skills, as opposed to more routine, low-level skills (McLeod, 1992; McLeod & Adams, 1989). Affective responses are seen as a critical variable if students are going to be active learners of mathematics and willing to attack non-routine problems.

The existing research on affect has focused chiefly on three areas: beliefs, attitudes, or emotions. Researchers have examined beliefs about mathematics that are held by students or teachers, or beliefs about oneself in relation to mathematics. Other researchers have investigated the attitudes of mathematics learners. Others are beginning to look at the more emotional responses to mathematics. The emerging literature highlights the importance of attending to non-cognitive factors such as metacognition, affect, and beliefs (Dweck, 1986; Schoenfeld, 1992), when considering cognitive outcomes.

Teachers believe strongly that certain affective variables (usually those dealing with motivation and self-esteem) are critical to students' success or failure in mathematics (Fennema & Peterson, 1985). Both student and teacher attitudes and perceptions of mathematics are important factors in the learning of mathematics (e.g. Ernest, 1991; Fennema & Leder, 1990; Fennema & Peterson, 1985). Correlational studies have confirmed the relationship between affective variables and student achievement (Fennema & Sherman, 1978). Meyer (1986) used LISREL to explore the relationship between causal attributional patterns, confidence, and mathematics achievement.

The importance of affective factors, as demonstrated by research in mathematics education, is reflected in recent curriculum statements worldwide. The *Curriculum and Evaluation Standards* (National Council of Teachers of Mathematics, 1989) stress the importance for students to value mathematics and become confident in one's ability to do mathematics, and claimed that the mathematics curriculum must "build beliefs about what mathematics is, about what it means to know and do mathematics, and about (students') views of themselves as mathematics learners" (p. 16-17). Major goals stated in *Mathematics in the New Zealand Curriculum* (1992) concern helping students to develop a belief in the value of mathematics and its usefulness, nurturing confidence in their own mathematical ability, fostering a sense of personal achievement, and encouraging a continuing and creative interest in mathematics. The development of skills, concepts, understandings, and **attitudes** which will enable them to cope confidently with the mathematics of everyday life is seen as a priority.

Recently, the National Research Council (1989, p. 13) suggested that the "public perception of mathematics is shifting from that of a fixed body of arbitrary rules to a vigorous active science of patterns." Attitudes towards usefulness of mathematics were also noted: "Public attitudes about mathematics are shifting from indifference and hostility to recognition of the important role that mathematics plays in today's society" (p. 12).

However, the Second International Association for the Evaluation of Educational Achievement (IEA) study, (Robitaille & Garden, 1989) noted that large differences among countries on measures of mathematical beliefs and attitudes, both among teachers and students can be important factors in initiating curriculum reform. Dillon (1993), in her ethnographic study of reformed mathematics teaching in elementary school, found that the community's traditional beliefs about mathematics (e.g., the importance of drill and practice on the standard computational algorithms) were so strong as to seriously hinder the reform-oriented project. More generally, widespread negative student views about mathematics conflict with curriculum goals and current reform efforts, particularly efforts to develop students' problem-solving activities (McLeod, 1994).

Affective issues also play an important role in influencing the practice of mathematics teaching and subsequently the students' learning processes and outcomes. Grouws and Cramer (1989) provide evidence that there are important links between the way teachers organize and conduct problem-solving lesson and the affective responses and tendencies of their students. The relationships are complex however; "certain teaching conditions and structures may influence students affective responses to problem-solving" (p. 160). For example, Cobb (1986) suggests that if a student asks a teacher for confirmation about the rightness or wrongness of a piece of work as soon as it is completed, this is evidence of the fact that the teacher is seen by the student as an authority. However, it is also evidence of the student's perceptions of the nature of mathematics are a kind of knowledge that can always be assessed in terms of correctness or incorrectness. Cobb states that "this inference would be further substantiated if the teacher responds by attempting to initiate a Socratic dialogue and the student shows irritation or frustration" (p. 4). For such a student mathematics is not seen to be a subject for exploration or discussion where the possibility of negotiation about methodology or content may exist. The expectation is that alternatives do not exist.

Knowledge of beliefs about mathematics may be one of the keys to a better understanding of mathematics learning process (Silver, 1985). The process of task definition is considered a function of the belief systems of those participating in the task (Schoenfeld, 1985). From this perspective, beliefs perform the function of framing or defining the task at hand. Implicit in this argument is a view of cognitive processing entailing several qualitatively different levels or categories of thought or knowledge possessed by the individual, can be brought to bear on the problem at hand (Schoenfeld, 1983). Individual knowledge includes metacognitive processes; the deliberate, conscious control and co-ordination of cognitive resource (Schoenfeld, 1983; Flavell, 1979). Strategic thought involves the conscious selection and use of tools of thought from a repertoire of cognitive resources to solve a certain type of problem. This is the point at which beliefs become an important determinant of task or problem definition.

Students have a wide range of beliefs about the nature of learning based on their own learning experiences. For example, I believe learning is hard work; it needs a good attitude, takes time, effort, other people's help and goodwill. Most students believe that mathematics problems can be solved in 12 minutes or less if the material is understood (Schoenfeld, 1989). Most mathematics is taught as a series of small exercises designed to test student mastery of topics. As a result, when students fail to solve a problem within a few minutes, they often abandon the problem, incorrectly concluding that they do not understand the material or are not able to complete the exercise.

The importance of affective factors in partially explaining individual differences in the learning of mathematics is well recognized (McLeod, 1994). In particular, affect appears to have important implications for gender-related differences in mathematics achievement (Fennema & Peterson, 1985; Fennema, 1989) and the election of mathematics courses beyond minimum requirement (Fennema & Sherman, 1976b). A positive attitude to mathematics is generally assumed to influence students' decision to continue with mathematics courses once they are no longer compulsory (Eccles, 1983; Haladyna *et al.*, 1983). It is acknowledged that because of the widely recognized role of mathematics as a critical filter into other courses and careers the importance of other variables are likely to interact with the attitude to mathematics component as determinant of mathematics participation.

In mathematics education most researchers seem to assume that the development of beliefs about mathematics is heavily influenced by the cultural setting of the classroom (Schoenfeld, 1989; McLeod, 1992). Thus, it seems reasonable to hypothesize that affective factors are particularly important in performance outcomes of groups that come from different cultural backgrounds. Hess *et al.* (1987) noted that Asian-American beliefs and attitudes resembled those of indigenous Asians more closely than those of their American peers. This was interpreted as suggesting that cultural beliefs are stable and transmitted through the family. There are also possible links between affective factors and home background factors such as the educational levels of the parents, family size and family support. More extensive examination of the relationship of cultural influences to achievement, through affective and motivational sources, was deemed warranted.

Most recently, new brain research suggests that emotions rather than IQ may be a true measure of human intelligence

(Time, October, 9, 1995). Saloway and Mayer (1990) propose the term "emotional intelligence", defined as "intelligence that involves the *ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions*" (p. 189). The introduction of emotional intelligence into discussions of mathematics education suggests that both facilitating and debilitating emotions play a significant role in learning, and that the emotional qualities of classroom interactions will exert a significant influence on what is learned. For example, if young women view mathematics classes as environments conducive to embarrassing public exposure (Anthony, 1994b), and unwelcome risk and competition, then one can see why young women often fail to persist in mathematics. Incorporating a facilitating view of emotions would allow one to recognize, for instance, that the tendency of young women to seek a deeper level of understanding, because of holding less instrumental views of mathematics, is a positive characteristic.

In summary, there are three facets of students' affective experience of mathematics learning that seem particularly important McLeod (1989, 1992):

* Students will develop positive or negative attitudes toward mathematics as they encounter the same or similar mathematical situations repeatedly.
* Students hold certain beliefs about mathematics and about themselves that play a important role in their affective responses.
* As interruptions and blockages are an inevitable part of the learning of mathematics, students will experience both positive and negative emotions as they learn mathematics. These emotions are likely to be more noticeable when the tasks are unfamiliar.

Research studies provide a substantial amount of data that indicate we have good reason to be concerned about affective factors. Students' beliefs and attitudes are now considered to be critical mediators in the learning process and as such the development of appropriate beliefs and attitudes are now incorporated as specific aims in recent curriculum reforms.

To situate the development and role of affective factors more firmly in current learning theories and reforms some background on the widely accepted learning paradigm of constructivism follows.

2.6 Constructivism in Mathematics Teaching and Learning

Constructivism as a theory of knowing holds the following principles as central (von Glasersfeld, 1990):

1. Knowledge is not passively received either through the senses or by way of communication. Knowledge is actively built up by the cognizing subject.
2. a. The function of cognition is adaptive, in the biological sense of the term, tending toward fit or viability.

   b. Cognition serves the subject's organization of the experiential world, not the discovery of an objective ontological reality.

The basic assumption is that children are active learners and must construct for themselves mathematical knowledge. The teacher provides appropriate materials and a social context within which the material is discussed but does not lecture or guide discussion in the traditional sense (Cobb *et al.*, 1992; Lampert, 1990).

This view of teaching and learning contrasts the behaviouristic view of mathematics education in which the attention was focused on observable behaviours, not on mathematics thinking. Technological advances have all but eliminated the need for paper-and-pencil computational skill. As a result, a major thrust of the reform movement has been the effort to replace the current obsolete, mathematics-as-computation curriculum with a curriculum that genuinely embraces conceptual understanding, reasoning, and problem solving as the fundamental goals of instruction. Accordingly, teaching based on a "constructivist" view of learning must be guided by knowledge of the conceptual advances that student need to make for various mathematical topics and of the processes by which they make these advances.

Central to constructivism is the role of existing knowledge: prior knowledge influences what information is selected and attended to, and what meaning is given to that information. Prior knowledge not only includes domain knowledge, but also metacognitive knowledge, beliefs and attitudes.

Constructivism also acknowledges that learning is influenced by the "social and cultural context in which learning takes place, including the physical structure, the purpose of the activity, the existence of collaborative partners and the social milieu in which the problem is embedded" (Hennesy, 1993, p.1). In particular, the social and cultural context in which learning takes place influences the opportunities for social interactions with peers, and teacher in which students attempt to explain their interpretation and listen to others' understandings - all important processes in the knowledge construction process (Garrison, 1993).

Social disagreement about the meaning of mathematical materials or concepts provide the grist for mathematical development, because these disagreements provide the impetus to change or accommodate one's understanding of such concepts. Any such changes serves to make the child's understanding of mathematics more consistent with the understating of the larger social community (Steffe, 1990).

Leder and Gunstone (1990) point out not only are mathematical conceptions personally constructed so are perceptions, attitudes, and abilities. Thus, the present study explores the students' attitudes and beliefs in relation to mathematics teaching and learning on the assumptions of the constructivist theory.

2.7 Theoretical Model

Autonomous learning is considered essential to the development of higher order thinking in mathematics (Anthony, 1994a). The Autonomous Learning Behavior [ALB] model, proposed by Fennema and Peterson (1985), and modified by Fennema (1989) has implications for the role of affect in mathematics classroom learning environments. The model (Figure 2.1) postulates that autonomous learning behaviours, such as "working independently on high-level tasks, persisting at such tasks, choosing to do and achieving success in such tasks" (Fennema and Peterson, 1985, p. 20), mediates the relationships between affect (internal beliefs), teachers (one external factor) and outcomes (including achievement). Teacher influences on students' internal beliefs and on participation include "the things the teacher says and does, the beliefs and expectations held by the teacher, and the activities in which learners are expected and encouraged to participate" (Fennema, 1989, p. 213).

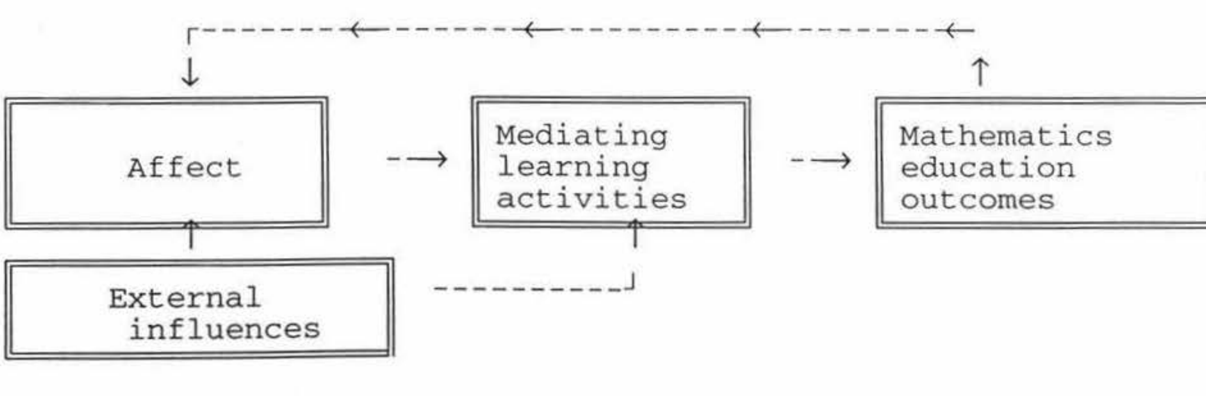

Figure 2.1 Fennema's Generic Model for Relating Affect and Outcome

(Adapted from Fennema (1989))

Anthony (1994a) also notes in the Interactive Model of Learning Mathematics that the mathematics outcomes include conceptual knowledge, problem solving, and affect.

The schematic presentation relating attitudes, beliefs, and mathematics learning (Figure 2.2) further illustrates the cyclic relationship of affect both producing and being produced by outcomes. In such a cyclic relationship students' learning experiences are likely to contribute to their beliefs about what it means to learn mathematics. In turn, their beliefs about mathematics are likely to influence how they approach new mathematical experiences. This apparent relationship between beliefs and learning raises the issue of how the cycle can be used to reinforce positive attitudes. An approach is to help students and teachers become aware of the attitudes and beliefs that they hold about mathematics through research studies such as this.

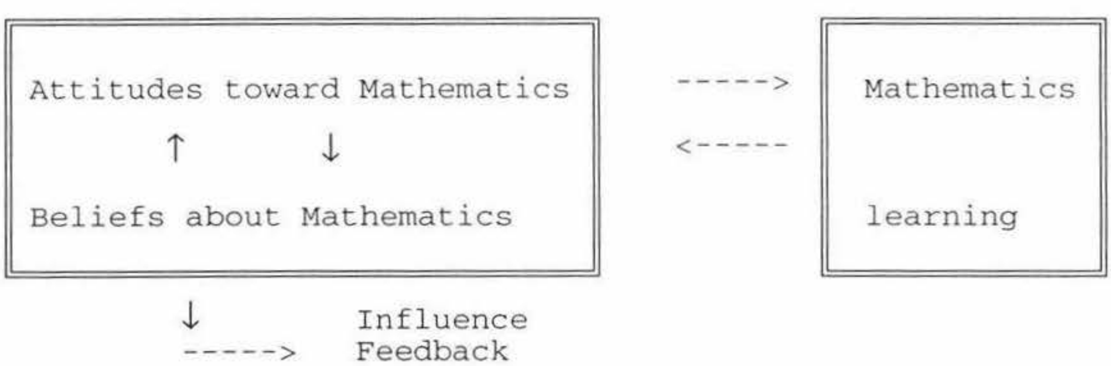

Figure 2.2 Schematic Presentation of Conceptual Framework Relating Attitudes, Beliefs, and Mathematics Learning

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

This chapter presents findings from the research literature concerning students' attitudes toward mathematics and related issues, and students' beliefs about mathematics and themselves as mathematics learners, beliefs about home support, and related issues. While cross-cultural comparisons of affective issues were evident in the literature search (e.g., Husen 1967; Robitaille & Garden, 1989; Stevenson & Stigler, 1992; Travers & Westbury, 1989), the researcher was unable to locate any studies which compared New Zealand and Indonesian students in particular.

3.2 Attitudes in Mathematics Education

3.2.1 Formation of Attitudes

An attitude is generally defined to have three components: attitudes are learnt (the cognitive component), attitudes predispose towards action (the behavioural component, linked with motivation), actions may be either favourable or unfavourable (the evaluative component) (Leder, 1992a). Despite various definitions of attitude, and the wide range of attitudes existing in the mathematics education literature, there is general agreement that attitudes are learned through experience (Fishbein & Ajzen, 1980), not inherited. Attitudes cannot be directly taught, but develop over an extensive period of time (De Corte, 1995).

An important component of attitude development is the evaluative component: attitudes can be evaluated as either positive or negative. Positive attitudes toward mathematics would be reflected in a student's positive perception, enjoyment of school mathematics and also being eager to learn mathematics. When students have positive attitude toward mathematics, learning processes are able to occur more effectively.

McLeod (1992) outlines 2 different ways in which attitudes develop: Firstly, attitudes may result from the automatization of a repeated emotional reaction to mathematics. For example, if a student has repeated negative experiences with adding fractions, the emotional impact will usually lessen in intensity over time. Eventually, the emotional reaction to fractions will become more automatic, there will be less physiological arousal, and the response will become a stable one. McLeod (1992) notes that this stable response (attitude) can probably be measured through use a questionnaire. A second source of attitudes is the assignment of an already existing attitude to a new but related task. For example, a student who has a negative attitude towards adding fractions may attach that same attitude to associated work in equation solving.

As such, formation of a mathematical attitude is a complex process involving the interaction of many factors. Among the factors influencing attitude development are the family, socialization, schooling experiences, relationship with role models and mentors, and culture (Taylor, 1992). Thus, when exploring attitudes toward mathematics it is necessary to consider students' attitudes toward the subject itself, their attitude regarding the teaching of mathematics, their enjoyment of mathematics, value (perceive usefulness) of mathematics, and their self-confidence in doing mathematics.

Moreover, Leder (1987, 1992a) noted that attitude toward mathematics is not a unidimensional factor; there are many different kinds of mathematics as well as a variety of feelings about each type of mathematics. For example, Fennema and Sherman (1976a, 1976b) constructed scales to measure "confidence in learning mathematics", "father, mother, and teacher scales measuring perceptions of attitudes toward one as a learner of mathematics", "effectance motivation in mathematics", "attitudes toward success in mathematics", "mathematics as a male domain", "usefulness of mathematics", and "mathematics anxiety scales".

Development of attitudes toward mathematics education begin as soon as children are exposed to the subject. Because the classroom is the primary setting for learning about mathematics in the society (Haladyna *et al.*, 1983), developing attitudes toward mathematics result from the interactions between the teacher and the students, and between student and student. Aiken (1986) noted that with American children; the junior years (age 11-13) appear to be particularly important; this is the period when negative attitudes toward mathematics becomes especially noticeable.

Prior studies have indicated that teacher attitudes and beliefs about mathematics and its teaching influence the instructional techniques they employ, the social-psychological classroom climate, and the management-organization (Thompson, 1984). Similarly, a strong relationship has been observed between teachers' beliefs about teaching and their beliefs about how students learn mathematics (Cobb, Wood, & Yackel, 1990). Such beliefs in turn, affects student attitudes (Fennema *et al.*, 1990; Haladyna *et al.*, 1983). From interviews with elementary school teacher, Prawat (1985) suggested that "teachers who place equal emphasis on affective and cognitive goals" are more effective in "promoting positive attitudes toward others and toward the class as a whole" (p. 559) than teachers whose goal orientations are primarily cognitive or primarily affective.

Attitudes toward mathematics can be also be shaped by students' perceptions of the nature of mathematics. It is commonly seen as a rigid subject consisting primarily of a body of facts and procedures; a symbolic, rule-driven abstract, and deductive discipline (Schoenfeld, 1992; McLeod, 1992). If mathematics is perceived as an authoritarian subject, feelings about it may merge with general feelings about authority. In adolescents, in particular, this may be reflected in negative feelings. Attitudes whether positive or negative are usually consistent and difficult to alter.

Hoyles (1982) analysis of students' subjective experiences with school situations suggests that students can feel quite strongly about their learning experiences and themselves as learners and they frequently express a connection between their feelings and specific instructional experiences. When discussing mathematics, students expressed strong feelings about learning and their own competence. In particular, bad maths experiences were characterized by feelings of anxiety, shame, and inadequacy.

Inclusion of situational variables such as the environment, culture and other people, reflect important components of the expectancy-value and attributional theories of attitudes (Taylor, 1992). The Family Maths program and research studies concerning the parental influences (e.g., Onslow, 1992) reflects the assumption that students' attitudes to mathematics are influenced by those of important others (e.g., parents) in their environment.

Of great concern is the findings from many research studies (Fennema & Sherman, 1976a; Sandman, 1980) of the widespread development of negative attitudes such as disinterest, lack of motivation, self-confidence, and mathematics anxiety. The following sections discuss specific research studies associated with mathematics anxiety, self-confidence, and motivation.

3.2.2 Mathematics Anxiety

Faced with mathematical situations, some people simply freeze; others do whatever they can to avoid situations that threaten to involve then in the use or discussion of mathematics. This problem is generally acknowledged as significant and referred to in the literature as mathphobia or mathematics anxiety (Buxton, 1981; Tobias, 1978).

Mathematics anxiety has been most frequently explained as the result of negative attitudes and affective reactions to mathematics (Fennema & Sherman, 1977, 1978). Such feelings of tension or dislike of mathematics interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations and is often related to poor performance on mathematics achievement tests and self-efficacy expectations (Hembree, 1990).

In meta-analysis research Hembree (1990) found that positive attitudes toward mathematics consistently related to lower mathematics anxiety, with strong inverse relations observed for an enjoyment of mathematics and self-confidence. Small correlations were found between mathematics anxiety and desire for success and a view of mathematics as male-oriented.

Hembree noted that female students reported higher mathematics anxiety levels than males. Similarly, Tobias (1987) found that females exhibited higher anxiety and associated negative attitudes towards mathematics than males. However, this was not reflected in performance results. This paradox may be explained along two lines: 1) females may be more willing than males to admit to their anxiety, in which case, their higher levels are no more than a reflection of societal norms; 2) females may cope with anxiety better.

3.2.3 Self-confidence

Inversely related to mathematics anxiety is self-confidence (Fennema & Sherman, 1976b). Self-confidence includes the individual's belief in his or her ability to succeed in mathematics learning and problem-solving, as well as self-confidence with respect to his or her peers. Students who are confident of their ability in mathematics are more comfortable when confronting mathematical situations. "Confident students tend to learn more, feel better about themselves, and be more interested in pursuing mathematical ideas than students who lack confidence" (Reyes, 1984, p. 560). Confidence in learning mathematics shows one of the strongest positive relationship with mathematics achievement of any affective variables (Fennema & Sherman, 1977; Meyer & Koehler, 1990; Reyes, 1984). In a longitudinal study that followed students from grades 6 through 12, Meyer (1986) found that confidence in learning mathematics was the best affective predictor of later mathematics achievement and course taking.

Stage and Kloosterman (1991) indicated that students generally have a poor conception of the nature of mathematics and their own ability to perform. Dossey *et al.* (1988) reported that students in the United States become less positive about mathematics as they proceeded through school; both confidence and enjoyment of mathematics appear to decline as students move from elementary through secondary school.

As with mathematics anxiety, differences in confidence levels are often reported in gender comparisons. Meyer and Koehler (1990) found gender differences in confidence even when there were no differences in achievement. A longitudinal study by the Girls and Mathematics Unit, University of London, found that girls' confidence in themselves, and their abilities was gradually eroded from nursery school to fourth year high school. While girls performed as well as boys in mathematics, teachers tended to protect the girls by not encouraging them to take more challenging examinations (Walkerdine, 1989).

The impact of confidence is further noted in studies related to specific learning processes. Lester, Garofalo, and Kroll (1989) studied the influence of confidence, interest, and beliefs on the problem-solving behaviour of seventh-grade students. They found groups of students were at times "almost helpless in solving mathematical problems" (p. 80) because of a lack of confidence. They hypothesized that confidence in learning mathematics, student beliefs about mathematics, and student beliefs about problem solving are "dominant forces in shaping" (p. 85) students' mathematical behaviour.

Cross-cultural studies have also noted differences in confidence levels. Whang and Hancock (1994) found that Asian-American students differ significantly from non-Asian students. Differences reflected Asian-American students' lower self-concept of mathematics ability and their belief that their parents share that conception.

3.2.4 Motivation

Motivation has to do with "why people pursue certain goals instead of others" (Ames & Ames, 1984, p. xi). From previous discussion (Section 3.2.1) Leder (1992a) suggests that one of three components of attitude is predisposition towards action (the behavioural component, linked with motivation). Likewise Haladyna *et al.* (1983, p. 20) describes attitudes towards mathematics "as one of a constellation of variables included in the students' motivational level."

Goals that tend to motivate academic achievement behaviour are frequently categorized as intrinsic or extrinsic. Extrinsic and intrinsic goals are not on a continuum; individuals generally have both as motivators. Extrinsic motivation may enhance performance and persistence when a student has knowledge that future valued rewards are possible. Extrinsic goals may be social goals such as pleasing others, or other rewards such as grades, stars, or praise (Stipek, 1988). It is difficult to motivate learning consistently through extrinsic rewards; indeed, the use of extrinsic incentives may impede learning, since students focus on obtaining rewards rather than upon the task itself (Nicholls, 1983). Furthermore, research suggests that students who are extrinsically motivated to study mathematics with the prospect of an immediate and valued reward, will withdraw from study or decrease effort when expected and valued rewards do not occur (Deci, 1980).

Intrinsic goals can be task-related, such as understanding concepts, or feeling good about solving a problem, or ego-related goals, such as performing better than others or showing more intelligence than others. Intrinsic motivation focuses on perceived autonomy or self-control versus external control, task involvement, and competence-striving (Nicholls *et al.*, 1990).

Malone and Lepper (1987) suggest that intrinsic motivation in learning activities can be encouraged by: (a) providing an appropriate level of challenge, (b) appealing to the sense of curiosity, (c) providing the learner with a sense of control, and (d) encouraging the learner to be involved in a world fantasy.

Recent research on motivation in mathematics education has focused on topics such as **reinforcement, need for achievement, locus of control, and most recently attribution.** Attribution will be discuss more fully in Section 3.3.3.

Reynolds and Walberg (1992) found that motivation and home environment had the greatest indirect effects on Grade 11 mathematics attitudes, primarily through complex paths involving prior attitude. "This represents the transmission of parental influence and individual persistence to attitude development, even in high school" (Reynolds & Walberg, 1992, p. 378).

3.2.5 Relationship between Attitudes and Mathematics Achievement

Despite the wide spread belief that positive attitudes are beneficial for learning outcomes earlier research studies failed to find high correlation between attitudes and achievement. Schibeci (1984) argues that some researchers appear take less care in measuring affective variables reliably and validly than in the measurement of the cognitive variables. He noted that much of the research reported only simple bivariate relationship, ignoring the likelihood that more complex and subtle relationship between attitudes and achievement may exist. At a conceptual level, Schibeci (1984) suggests that much of the research lacks a theoretical framework concerning the nature of attitudes and the processes by which they relate to school learning and achievement.

In the past, for example, some researchers have claimed that negative attitudes result in poor achievement in mathematics, while others have said that poor achievement in mathematics has produced negative attitudes. However, the existence of a link between attitude and achievement does not necessarily mean that improvements in one will automatically lead to improvements in the other - "...neither attitude nor achievement is dependent on the other; rather, they interact with each other in complex and unpredictable ways" (McLeod, 1992, p. 582). For example, data from the *Second International Mathematics Study* indicate that Japanese students had a greater dislike for mathematics than students in other countries, even though Japanese achievement was very high (McKnight *et al.*, 1987).

In Indonesia, Simanungkalit (1988) examined the relation of attitudes and test anxiety with mathematics achievement in tests. It was found that with students from A_1 (Physics) and A_3 (Social Sciences), the degree of aberrance of their responses toward mathematics test was negatively related to their **attitude towards mathematics**, but positively related to their test anxiety on mathematics.

Djaali (1984) examined the influences of study habits, **attitude**, aptitude and teaching-learning process upon mathematics achievement of senior secondary students. He found the factors which influence the mathematics achievement of science students can be expressed respectively as follows: 25.6% by their quality of learning, 14% by their arithmetic abilities, 9.3% by their capabilities to think abstractly, 3.2% by the amount of time they spend studying mathematics, and 0.6% by their clerical speed and accuracy. The factors which influenced mathematics achievement of social sciences students were expressed respectively as 19.4% by the amount of time they spent studying mathematics, 17.1% by their quality of learning, **5.5% by their attitudes toward mathematics**, 4.7% by their capabilities to think abstractly, 2.5% by their capabilities on arithmetics, and 2% by their clerical speed and accuracy. From the previous discussion (see Section 3.2.1 Formation of Attitudes) one would expect students' attitudes to influence the quality of learning which played a significant role in achievement outcomes of both science and social sciences students.

At the tertiary level in Indonesia studies have been undertaken by Abd.Rahman (1991) and Isjana (1993). Abd.Rahman (1991) examined the prediction of achievement of undergraduate students in mathematics and science based on their cognitive entry behaviour, achievement motivation, and attitude. His findings suggest that there is: (1) a correlation between cognitive entry behaviour and achievement motivation with achievement in mathematics; (2) a correlation between **attitude toward mathematics** with achievement in mathematics; (3) a correlation between achievement motivation and **attitude toward mathematics**; (4) a correlation between cognitive entry behaviour, achievement motivation, and achievement in mathematics. He concluded that cognitive entry behaviour made the highest contribution, followed by achievement motivation, and **attitudes toward mathematics**, while the combination of all predictor variables could be used to predict the achievement of undergraduate students in mathematics and science.

Similarly, Isjana (1993) studied the effects of self concept, achievement motivation, and learning habits on student achievement. He found that separately or together these three variables had a significant effect on student achievement.

In New Zealand, Naftel (1974) analyzed the attitudes and achievement of mathematics students participating in an individualized instruction program in an intermediate school. He found that these students showed a significant positive change in attitude and achievement. Some evidence was obtained of the differential effects of the individualised programme on children at different ability levels and there was also evidence of a gender difference interaction.

Slyfield (1988) found gender differences in attitudes towards specific topics. In study of New Zealand primary aged children it was found that boys were more likely to like multiplication and addition, problem solving and using mathematical equipment, such as a calculators, protractors or abacus. More girls than boys disliked difficult work and fractions. Boys were more likely to state that there was nothing they disliked about mathematics. Furthering our understanding of these attitudes may go some way to explain performance gender differences as noted in the IEA study of standard 4 girls (May & Lamb, 1987).

3.3 Beliefs in Mathematics Education

3.3.1 Beliefs about Mathematics

In mathematics education beliefs can be categorised into two main types: (1) beliefs about mathematics and the nature of mathematical task and (2) beliefs about oneself and others as doers/learners of mathematics (Schoenfeld, 1987). Together these beliefs influence how one studies mathematics, how one thinks about, approaches, and follows through on mathematical tasks, and how and when one attends to mathematics instruction. Schoenfeld (1985) thinks of these beliefs as reflecting one's "mathematical world view" because they "establish the context in which mathematics is done" (p. 45).

Beliefs about mathematics, like beliefs about anything else, race, religion, sex, and politics, to name a few, are shaped by one's environment. We may endorse our culture's values, or rebel against them, but we are shaped by them just the same. Beliefs about mathematics do not develop overnight. They develop slowly, over a long period of mathematical encounters and experiences (McLeod, 1992). Most students' primary source of mathematical experiences are the mathematics classroom.

Schoenfeld (1992) lists some of the typical student beliefs about the nature of mathematics and mathematical activity:
* Mathematics problems have one and only one right answer.
* There is only one correct way to solve any mathematics problem - usually the rule the teacher has most recently demonstrated to the class.
* Ordinary students cannot expect to understand mathematics; they expect simply to memorize it and apply what they have learned mechanically and without understanding.
* Mathematics is solitary activity, done by individuals in isolation.
* Students who have understood the mathematics they have studied will be able to solve any assigned problem in five

minutes or less.

* The mathematics learned in school has little or nothing to do with the real world.

Students learn much more than mathematics content from classroom experiences, developing mathematical beliefs that can help or hinder them as learners (Leder & Gunstone, 1990). Mitchell (1984) identified "maths myths"; defined as a belief about mathematics that is (potentially) harmful, resulting in false impressions about how mathematics is done. Common maths myths identified by Buerk (1985) include the belief that mathematics is collection of right answers and correct methods, that mathematics is cold and logical, that mathematics is not intuitive or creative, and that mathematics is learned by memorization and by having a mathematical mind. Buerk found such beliefs interfered with students' understandings of mathematics and with their confidence in their ability to do mathematics. Similarly, Brown *et al.* (1988) indicated that students believe that mathematics is important, difficult, and based on rules. These beliefs about mathematics, although not emotional in themselves, certainly would tend to generate more intense reactions to mathematical tasks than beliefs that mathematics is unimportant, easy, and based on logical reasoning.

More recently, Lampert (1990) has summarised beliefs about the nature of mathematics and mathematical activity as follows:

> Commonly, mathematics is associated with certainty; knowing it, with being able to get the right answer quickly (Ball, 1988; Schoenfeld, 1985b; Stodolsky, 1985). (p. 32)

Lampert (1990) strongly suggests that such beliefs are shaped by "school experience, in which **doing** mathematics means following the rules laid down by the teacher; **knowing** mathematics means remembering and applying the correct rule when the teacher asks a question; and mathematical truth is determined when the answer is ratified by the teacher. Belief about how to do mathematics and what it means to know it in school are acquired through years of watching, listening, and practicing" (p. 32). Thus, even though teachers do not necessarily share these beliefs, the traditional curriculum in the traditional classroom often provides support for the development of such beliefs.

Stodolsky (1985) describes how beliefs about mathematics influence students' (and teachers') performance in the mathematics classrooms, especially as compared to social studies classrooms. In social studies, students are much more likely to work in groups, to develop their research skills, and in general to work on tasks that are compatible with the development of higher-order thinking skills. In mathematics classrooms, on the other hand, students spend a lot of time doing individual seatwork. Similarly Alexander (1992), in her comparison of mathematics and social studies teaching, concludes that mathematics is generally taught "on the basis of well establish rules" (p. 37). Social studies, in comparison, generally deals with problems that are ill-structured. Other researchers have noted how students view mathematics as a skill-oriented subject (McKnight *et al.* 1987). Such limited views of the discipline lead to anxiety about mathematics (Greenwood, 1984) and more generally interfere with higher-order thinking in mathematics (Garofalo, 1989).

3.3.2 Beliefs and Problem Solving

Research on beliefs has been a major focus in studies of problem solving. Silver (1985) stated that beliefs about mathematics should be studied to better understand how students learn problem solving.

Stevenson and Stigler (1992) present compelling evidence that mathematics instruction based on having students practice prescribed computational procedures is not working well. In particular, many U.S. students see mathematics as computing rather than a sense-making activity. Students who believe computation is the key to mathematics learning will have less motivation to be good problem solvers than students who feel that problem solving is important (Schoenfeld, 1985).

Research reported by Lesh (cited in Silver, 1985) suggests that many students' failure to solve mathematical problems can often be directly attributed to their erroneous beliefs about the nature of mathematics and mathematics problem solving. Students may hold beliefs about mathematics that weaken their ability to solve nonroutine problems. If students believe that mathematical problems should always be completed quickly, they may be unwilling to persist to solve nonroutine problems that take substantially longer. Also students may believe that only geniuses can be creative in mathematics, or that proof just confirms the obvious (Schoenfeld, 1992).

Recent research emphasizes the role that beliefs systems play in determining the kinds of managerial decisions that problem solvers make. Thus metacognition, the awareness of one's own cognitive processes and the regulation of cognition is crucial in problem solving (Garofalo & Lester, 1985). In a study involving story problems at seventh-grade level, Lester, Garofalo, and Kroll (1989) examined the role of metacognitive control. In order to explain the context in which metacognitive decisions were made the researchers also gathered data on affective factors, including children's beliefs about themselves as problem solvers and their attitudes toward problem solving. The data from this study supports the view that the social context and the beliefs which it engenders have an important influence on both the students' affective responses as well as their metacognitive acts. It seems to take a long time for a students to realize the possibility that they are able to control whether or not they learn mathematics. Sometimes student needs help with study skills, and the development of appropriate metacognitive beliefs and learning strategies. Anthony (in press) suggests that presently many instructional factors do little to develop appropriate metacognitive beliefs necessary for students to believe that they are able to actively construct their own mathematical knowledge.

Issues on belief occupy a precarious middle ground between primarily cognitive and primarily affective determinants of mathematical behaviour (Schoenfeld, 1985). We can thus think of cognitive resources, metacognitive control strategies, and beliefs systems as progressively more encompassing system of thought. In particular, attitudes toward mathematics and confidence about mathematics may be aspects of student belief systems that affect students' management of their cognitive resources.

3.3.3 Beliefs about Themselves as Learners

Beliefs about self have been investigated under the rubric of causal attribution of success and failure. Attribution theory explains motivation in terms of students' perceptions of the reasons for their success and failure rather than as simply a drive or a trait. (see Table 3.1)

Table 3.1 Attribution to success and failure

	Internal		External	
	Stable	Unstable	Stable	Unstable
Not controllable	Ability	Mood	Task difficulty	Luck
Controllable	Typical effort	Immediate effort	Teacher bias	Unusual help from others

(Adapted from Weiner, 1986)

Weiner (1986) developed three main attribution dimensions: locus (internal or external), stability (e.g., ability versus effort), and controllability of the causal agent. For example, a student who fails to solve a mathematics problem could say that the problem was too hard, a cause that is external, stable, and uncontrollable by the student. A student who succeeds in solving a problem might attribute that success to effort, a cause that is internal, unstable, and controllable.

Accordingly, the attribution by which an individual explains her or his own success or failure influence her or his future achievement. Motivation, or learning task orientation, affects the types of tasks students choose and the amount of effort they are willing to expend (Kloosterman, 1990). Attributing success to abilities and failure to bad luck or less effort increases the future achievement expectations, whereas the reverse in which success is due to effort and luck, and failure is due to a lack ability decreases the expectations. There is some indication that the first attribution pattern is characteristic for males and the latter for females (Leder, 1981; Wolleat *et al*, 1980). Eccles *et al.*, (1982) suggested that the attributional style of females differs from that males, especially when it comes to failure. Females were more likely to learn helplessness, whereas males protect themselves from failure by attributing it to bad luck or to lack of effort.

With regard to effort, Helmke (cited in Boekaerts, 1993, p. 160) made a distinction between quantitative and qualitative effort. He found that mathematics students with low self-concept exerted a lot of quantitative effort. This led to cognitive interference and low mathematics achievement, whereas students who scored high on self-concept spent a lot of qualitative effort, which led to high mathematics achievement. Anthony (1994b) also noted that some low achievers, although effortful, could be distinguished by inappropriate and in effective strategic learning when compared with high achievers.

3.3.4 Teacher Beliefs

Teachers' goals for mathematics instruction depend on their conceptualization of what mathematics is and what it means to understand mathematics (Ernest, 1989; Hersh, 1986). Thompson (1984) claimed:

> There is strong reason to believe that in mathematics, teachers' conception (their beliefs, views, and preferences) about the subject matter (**mathematics**) and its teaching play an important role in affecting their effectiveness as the primary mediation between the subject and the learners. (p. 105)

Thompson (1984) showed a consistent relationship between teacher' beliefs about the nature of mathematics and their instruction practices. She noted the influence of the following beliefs:

The primary purpose of mathematics is to serve as a tool for the sciences and other fields of human endeavour.

Mathematics is accurate, precise, and logical.

Mathematics is mysterious--its broad scope and the abstractness of some of its concepts make it impossible for a person to understand it fully.

The content of mathematics is 'cut and dried' offers few opportunities for creative work.

Mathematics is logical and free of emotions. Its study trains the mind to reason logically. Mathematical activity is like "mental calisthenics". (p. 110, 113, 116)

Teacher beliefs influence their action in the classroom. What teachers believe about the nature of mathematics and about the nature of learning and teaching has been shown to be as important as their mathematical knowledge. For example, a teacher who believes that mathematics is a set of facts and procedures often is the one who views the teaching of mathematics as the clear presentation of concepts and procedures. A teacher who believes knowing mathematics is the ability to recite facts and pattern computations often is one who views the learning of mathematics as drill and practice (Swafford, 1995).

The vision of school mathematics presented in the *Mathematics in the New Zealand Curriculum* is one that views mathematics as problem solving and learning as the construction of knowledge through working on worthwhile mathematics tasks. Mathematics teachers will need focus on broader goals and allow for the fact that more than one strategy may be needed to teach mathematics; such as: conceptual understanding and the development of confidence and competence in mathematical problem solving and reasoning, but not proficiency in the rote memorization of algorithms (Schoenfeld, 1992). As such teacher beliefs are critical to successful curriculum implementation (Walshaw, 1994).

3.3.5 Self-efficacy

In recent years, self-efficacy theory has received considerable attention as a framework for understanding students' academic performance, persistence, and perceived career options (Lent & Hackett, 1987). Self-efficacy expectations, beliefs about one's ability to perform specific tasks are presumed to influence a wide range of behavioral outcomes, including one's preferences for particular tasks, and one's effort expenditure and persistence at these tasks in the face of obstacles (Bandura, 1986). For example, students who believe that their performance is contingent on their own actions outperform those who do not have such favourable beliefs (Bandura, 1986; Schunk, 1989). Accordingly, people's behaviour can often be better predicted by their beliefs about their capabilities rather than by what they are actually capable of accomplishing.

Self-efficacy beliefs are shaped by four major sources: (a) past performance accomplishments, (b) exposure to and identification with efficacious models (vicarious learning), (c) access to verbal persuasion and support from others, and (d) experience of emotional or physiological arousal in the context of task performance. Of the four sources, past performance accomplishments are generally assumed to be most influential in promoting self-efficacy given that they are based on authentic mastery experiences (Bandura, 1986).

Hacket (1985) proposed a causal model of mathematics self-efficacy as a possible explanation for the large gender differences that continue to exist in the numbers of male and female students who select mathematics-oriented college majors. Hacket found that an individual's perception of their mathematics self-efficacy was the most powerful predictor of their occupational choice. More recently, Hacket and Betz (1989) reported that both mathematics performance and self-efficacy were positively and significantly correlated with attitudes towards mathematics and masculine sex-roles orientation.

3.3.6 Influence of Parents and Home Environment

Empirical studies by Eccles and Jacob (1986) found that parents and teachers can directly influence students' course selection by encouragement and expression of their expectations for boys' and girls' success or failure, and indirectly by providing different information to boys and girls in respect to the difficulty or importance of mathematics. Parents were identified as a critical force exerting a more powerful and more direct effect than teachers on children's attitudes toward mathematics.

Research also suggests that parents have lower levels of educational expectations for their daughters, especially in the areas of mathematics and science (Robitaille & Garden, 1989: Eccles *et al.*, 1983). Moreover, the stereotyped view of mathematics as a masculine subject, more appropriate for males to engage in, is supported by both parents (Shashaani, 1993; Jacobs, 1991). The combination of these views may deter females from becoming as involved (Jacobs, 1991) in their mathematics education as males (Walkerdine, 1989).

Research in cross-cultural settings also highlights the influence of the broader social context. The high performance of Asian children is a result of many factors; including cultural values, family involvement, and student motivation (see Chen & Stevenson, 1989; Chen & Uttal, 1988; Stevenson, Lee, Chen, Stigler, Hsu, & Kitamura, 1990; Stevenson & Stigler, 1992). In Asian countries Stevenson and Stigler (1992) noted an overall high expectation for all children, and the expectation that all children can achieve high standards if they are taught well and work hard. Such expectations mean that Asian students take more mathematics and have to meet higher standards both at school and at home than Western students. In contrast, Americans, and possibly New Zealanders, have tended to view achievement in mathematics as a product of special talent rather than effort.

Hess *et al.* (1986) notes that Japanese mothers interacted with their children in ways that promote internalization of adult norms and standards, whereas American mothers were more oriented toward application of external authority and direction. Furthermore, American mothers relied more on verbal explanations and the use of techniques encouraging verbalization by children, while Japanese mothers were more prone to emphasize following correct procedures as the route to understanding.

Hess *et al.* (1986) also studied the role of parental influences on development of attribution. Their research indicated that Japanese mothers believed that effort is the most important criterion in determining school achievement, while American mothers credit ability as being the most important factor. In a similar study Stigler and Perry (1988) found that Chinese and Japanese parents expect their children to work hard at mathematics, and their children generally respond positively to this expectation.

It is highly probable that these parental beliefs influence the amount of time and the effort that children devote to their school work, the development of efficacy and attributional beliefs, and achievement levels in the respective countries.

3.4 Gender Differences in Attitudinal and Beliefs Aspects

Mathematics educators have investigated gender as a variable in research concerned with mathematics achievement for a number of years (Fennema & Carpenter, 1981; Hall & Hoft, 1988). Typically, until age 10 either no differences are found, or the differences that are found favour females. In the middle-school years a mixed pattern develops; small gender differences sometimes in favour of girls, and sometimes in favour boys. Exceptions are noted in studies of gifted youth in which substantial differences favouring males are consistently found. Throughout the high school years differences favouring males are common; they are particularly apparent in problem-solving and applications tasks (Friedman, 1989).

Data gathered from 12 countries in the first two international studies of mathematics achievement (Husen, 1967) revealed "clear differences in favour of boys in all populations in both verbal and computational scores" (p. 241). Comparable data were presented by Robitaille and Garden (1989), and Travers and Westbury (1989) in their summaries of results from the Second International Mathematics Study (SIMS). However, there is some evidence that difference between boys and girls are smaller than they were a decade ago (Friedman, 1989; Hyde, Fennema & Lamon, 1990).

Hanna *et al.* (1990), when comparing achievement differences between countries, included many gender-related variables: teacher gender; students' stereotypical attitude towards gender; the degree to which students aspire to more education; gender-specific support from parents for their children's education; and the degree of parents' support.

Research focused on affect has noted small, but recurring differences, in favour of males between females and males in personal-belief variables, such as confidence, risk-taking behaviour, motivation, and related characteristics including fear of success, attributional style, learned helplessness, mastery orientation, anxiety, and persistence (Fennema & Leder, 1990; Leder, 1992b). For example, girls tend to consider mathematics a masculine domain (Fox, Brody & Tobin, 1985; Leder, 1986; Tartre and Fennema, 1995), and they show a less positive attitude towards mathematics than boys (Sherman, 1980). Boys have higher perceptions of their own competence and higher performance expectations than girls, even if girls have equal or better results (Eccles *et al.*, 1985; Hyde, Fennema & Lamon, 1990). While there is some evidence that gender differences in attitudes are decreasing (Hanna, 1989) Hyde *et al.* (1990) noted that it is somewhat premature to conclude that affect and attitude are not important influences on gender differences in performance and participation in mathematics.

Ethington (1990) noted that the performance patterns observed are consistent with the hypothesis that cultural factors affect observed gender differences in mathematic performance. Hanna *et al.* (1990), in an analysis of IEA results, found that in the countries where there was strong parental support for participation in mathematics by both boys and girls there were fewer gender-related differences in mathematics achievement, but in countries where there was less parental support for mathematical activities there were important gender-related differences. The indication that gender-related differences in mathematics are present in some countries but not in others supports the notion that differences in mathematics achievement stem from sociocultural factors. Eccles and Jacobs (1986) concluded "that parents' gender-stereotyped beliefs are a key cause of sex differences in students' attitude toward mathematics" (p. 375). Fennema and Sherman (1977) contend that parents are often more encouraging of their sons' than their daughters' mathematical studies. The reported effects are often small but may be significant when considered in the terms of cumulative impact over time (Leder, 1992b).

Teacher beliefs about gender differences in mathematics affect their instructional decisions and these, in turn, influence students learning (Fennema, 1990; Jungwirth, 1991). Research studies concerning classroom instructional practices, especially teacher interactions with students have found that males tend to receive more encouragement and more frequent praise for correct answers than females (Hart, 1989; Koehler, 1990; Leder, 1987). Different patterns of interaction were found for male and female students. Males were better able to conceal their failures while females' interaction styles reflected patterns of emerging failure. Jungwirth (1991, p.279) noted that "these results - competence and incompetence - are due to the modes of participation of the boys and the girls and to the corresponding practices of the teacher."

As discussed earlier (see Section 3.3.3), significant gender differences in attributions of success and failure in mathematics have been found (Eccles *et al.*, 1982; Leder, 1981; Wolleat *et al.*, 1980). Females were more likely to use effort, but less likely to give ability, as explanations for success; ability and task were more often perceived as the reason for failure.

While Eccles *et al.* (1984) found no gender differences in the perceived value or usefulness of mathematics for young children, they showed that during the high school years female students begin to value English courses more highly than mathematics course, whereas male students show the opposite pattern. The gender differences in the relative valuation of English and mathematics mediated a gender differences, favouring males, in the number of upper-level mathematics courses taken in 12th grade. Similarly Husen (1967) found that during the high school years, male students consistently perceive mathematics as being a more useful skill than do female students.

The perceive usefulness of mathematics appears to be related to long-term career goals (Chipman & Thomas, 1985). Not surprisingly those students who aspire to professions that are mathematics intensive, such as engineering or the physical sciences, take more mathematics courses in high school college than those students who have aspirations for less mathematics intensive occupations. Chipman and Thomas showed that women were much less likely to enter mathematics intensive profession than were equal ability men.

The relationship between gender and maths self-efficacy has been explored as thoroughly as that between gender and maths performance. Early studies suggested that boys were more confident in their maths skills (Fennema & Sherman, 1978; Meyer & Koehler, 1990). Recent findings suggest that boys and girls report equal confidence during the elementary years but, by middle and high school, boys grow more confident (Pintrich & De Groot, 1990; Driver, 1993).

Hacket and Betz (1989) concluded that differences in females' and males' mathematics self-efficacy expectations were correlated with performance differences between the two groups; the males, and to a slightly lesser extent females, tended to overestimate their performance and that mathematics-related self-efficacy expectations, rather than past or current mathematics performance, predicted mathematics-related educational and career choices.

Ngee (1980) found that male and female undergraduate students at Massey University showed differences between first year in their attitudes toward enjoyment of theoretical mathematics. The students valuing of theories was positively and significantly correlated with their enjoyment of theories and similarly their valuing of applications was positively and significantly correlated with enjoyment of applications.

In a comparative study, involving students from Thailand and United States, Tocci and Engelhard (1991) investigated the relationship of attitudes toward mathematics with mathematics achievement, parental support, and gender. They found that within both countries, achievement, parental support, and gender were significant predictors of attitudes toward mathematics. The data also suggested that there were gender differences in attitudes toward mathematics for 13 years old in the United States and Thailand. The largest gender differences were found on the mathematics as a male domain scale. These differences were still significant after controlling for achievement and parental support.

In summary, research studies indicate that beliefs are important in accounting for gender differences in mathematics achievement, in participation, and in affective responses to mathematics. "Both the educational environment and what a person believes about her/himself has a direct influence on what is learned in mathematics" (Fennema, Walberg, & Merrett, 1985, p. 304). It is important to keep in mind the complexity of the research on gender differences. Performance differences are observed in some areas of mathematics such as spatial and problem solving but not others, and in some cultures but not others (Hanna, 1989). There are substantial differences in beliefs about mathematics between males and females, as well across different cultures.

CHAPTER 4

RESEARCH METHOD

4.1 Introduction

This research is a comparative study of attitudinal and beliefs aspects in mathematics education between Indonesian and New Zealand. Data on student beliefs and attitudes was obtained from student interviews (conducted in Indonesia only) and from student responses to questionnaire developed by the researcher. Cross-national comparisons can help us discover characteristics of our own culture that we fail to notice because we are so familiar with them. Through such comparisons, our perceptions become clearer and sharper.

Comparative study is not an academic discipline; it is a field of study. "Therefore, because it borrows its theoretical and methodological principles ad hoc from a variety of social sciences, there is a fundamental, ongoing, and heated debate over precisely what comparative studies is and what are its rules of practice" (Mazurek & Winzer, 1994, p. xxvi).

Comparative studies in mathematics education have mainly used the country as the unit of analysis. Many articles and texts (e.g., Husen, 1967; Mazurek & Winzer, 1994; Robitaille & Garden, 1989; Stevenson & Stigler, 1992) are completely organized around countries, presenting information in chapters such as China, Japan, USA, and so on.

Cross-national comparison of affective issues evident in the literature search (e.g., Husen, 1967; Robitaille & Garden, 1989; Travers & Westbury, 1989; Stevenson & Stigler, 1992), mainly compare Western countries (especially USA) to Asian countries. The researcher was unable to locate any comparable studies which compare New Zealand and Indonesian students and/or teachers.

4.2 Subjects and Setting

Students: The subjects were senior secondary students (ages 16-18 years) currently studying mathematics. From Indonesia, 191 (92 boys and 99 girls) second-grade students from five classes (two from II A_1 (Physics), one from II A_2 (Biology), and two from II A_3 (Social Sciences)) all attending the same coeducation general senior secondary school in Jakarta participated in the study. The mix of students from A_1, A_2, and A_3 streams provided a similar mix of students (in terms of career aspirations and abilities) as would be expected in year 11 and 12 students from New Zealand. From New Zealand, 47 (23 boys and 24 girls) from a coeducation school in Palmerston North participated. They came from 2 classes in year 11 and 12.

Teachers: Indonesia mathematics teacher, 4 males and 4 females from the two secondary schools completed a questionnaire and 2 (1 males and 1 females) participated in interviews. The comparative New Zealand data for teacher surveys was from a study by Walshaw (1994) which involved thirteen secondary school mathematics teachers from 4 case schools in Manawatu region.

4.3 Instrument

Student questionnaire. A questionnaire was designed to measure students' attitudes and beliefs toward mathematics, their mathematics learning, and their mathematics teaching. It consisted of 70 closed, and 8 open, unstructured questions (Appendix A3 and A4). Additionally, the questionnaire included a biographical section asking students to indicate their grade, gender, and intentions for further study in mathematics.

The questionnaire was developed after the researcher conducted pilot interviews (January 1995) with secondary senior high school students in Jakarta, and with reference to existing attitudinal questionnaires (e.g., Schoenfeld, 1989).

The close questions consisted of Likert-type statements concerning attitude and belief. Oppenheim (1992) suggests attitude scales can be successfully divided into broad groupings, enabling one to study the relative rather than absolute relationship between grouping. Grouping selected included:

* enjoyment of mathematics (items 1-4);
* value (perceive usefulness) of mathematics (items 5-12);
* students' belief about mathematics (items 13-15);
* students' belief about themselves as mathematics learners (items 16-26);
* attribution to success and failure in mathematics learning (items 27-32);
* students' belief about mathematics learning (items 33-43);
* students' belief about home support (items 44-47); and
* students' belief about mathematics teaching (items 48-70).

Each statement used a single sentence that expressed a point of view, a belief, a preference, a judgement, an emotional feeling, a position *for or against* something phrased so that respondents can agree or disagree with the statement (Oppenheim 1992). For example, item no. 7 "If I know mathematics, it will help me to get a job"; This item was **positively** worded and scaled **5 for strongly agree and 1 for strongly disagree**. On the other hand, item no. 21 "I always feel nervous when I look at a maths problem"; This item was given **5 for strongly disagree and 1 for strongly agree.**

Teacher questionnaire. In order to characterize teachers' current and recent past beliefs about mathematics teaching practice a questionnaire (Appendix A5 and A6 adapted from Walshaw, 1994) of four component parts was given. The first two components of the questionnaire related specifically to teachers' beliefs about mathematics teaching and learning of school mathematics. The third component, based on a portion of IEA study (1981) questionnaire concerns teachers' specific teaching behaviours and personal beliefs about the nature of learning as mediated by specific classroom experiences. The fourth component indicated the resources used by teachers.

4.4 Procedure

The questionnaire was initially piloted in Indonesia in May 1995, and the length was reduced slightly to accommodate completion within the normal lesson time. The results (Table 4.1) indicate acceptable reliability levels.

Table 4.1 Cronbach's coefficient α

Means, standard deviations, and reliability coefficient (Cronbach α) Pilot testing (n = 30)

Subscales	means	sd	Cronbach α
Enjoyment of maths	11.9	0.944	0.718
Value of maths	30.3	0.748	0.649
Belief about maths	8.9	1.159	0.633
Belief about self as learners	36.5	0.911	0.647
Attribution	18.8	0.915	0.677
Belief about maths learning	32.6	0.900	0.666
Belief about home support	13.1	0.885	0.619
Belief about maths teaching	91.73	0.780	0.825

Notes: Maximum ratings / score possible: attitudes toward enjoyment of maths is 20, attitudes toward value (perceive usefulness) of maths is 40, belief about maths is 15, belief about themselves as learners is 55, attribution to success and failure in maths learning is 30, beliefs about maths learning is 55, belief about home support is 20, and belief about maths teaching is 115.

The internal consistency reliability of the questionnaire was computed with the Cronbach's coefficient α (Graham & Lilly, 1984). "Internal consistency refers to the extent to which all parts of the measuring technique are measuring the same concept. ...All structured questionnaires designed to measure single concepts, traits or phenomena on a quantitative scale are tested for internal consistency to ensure that all items are contributing consistency to the overall measure concept. (Brink & Wood, 1988, p. 176)

The student questionnaire (Appendix A3 and A4) was administered in Indonesia in May/June 1995 and in New Zealand in July 1995. The students completed the questionnaire in whole-classroom situations during their regular mathematics class. Their usual mathematics teacher administered the questionnaire. The instrument for Indonesian students was translated into Bahasa Indonesia by the researcher. The teacher questionnaire (Appendix A5 and A6) was also administered in Indonesia on June 1995 to 8 mathematics teachers.

Approval was granted by the schools, teachers, and the university ethics committee. All students were informed about the nature and objectives of the study, and participation was voluntary. To encourage honest responses and ensure confidentiality all responses were anonymous. Students appeared interested, genuine and cooperative participants. There was a very high question completion rate and a good responses to open questions in the questionnaire.

4.5 Data Analyses

Individual items were scored by assigning the number 1 to the least positive response (strongly disagree if the item was positively worded and strongly agree if the item was negatively worded) and so on up to the number 5 for the most response (strongly agree if the item was positively worded and strongly disagree if the item was negatively worded).

A directional t-test for independent means was carried out to determine if the mean attitudinal and beliefs score of New Zealand students was significantly different from Indonesian students. Also the scores between Indonesia and New Zealand students' beliefs and attitudes for each of the item categories were compared. The quantitative results of this analysis are discussed in the following chapter.

4.6 Limitations

The undertaking of comparative study, the utility of such studies, the confidence with which conclusions can be drawn, and the validity of potential lessons which may be learned are complex matters (Mazurek & Winzer, 1994). All data in this study were from self-reports and thus subject to social desirability biases. However, the efforts the ensure anonymity and the use of analysis by an independent researcher, rather than school-based research, may limit the bias effects. As Stigler and Perry (1988) point out that in the absence of experimental control, the most that we can hope for are relatively well-justified hints about what is really going on.

For this study, the generalisability of findings is restricted by sample locations. Financial constraints restricted this study to a small area of each country and relatively small sample size. Increasing the sample size (by extending the location of the study) would probably give different results because of variation of the other factors across the country which affect attitudinal and belief concepts, such as school types, teacher ability, socioeconomic status. However, while the comparative findings are representative of only two participating schools and their respective students it should be noted that the participating schools were regarded by the researcher to be representative of the majority of state secondary schools for their respective countries.

Probably a greater limitation than actual sample size is the fact that students were from only 2 (new Zealand) and 5 (Indonesia) classes. While acknowledging the effect of individual teachers on students' affect it is also noted that these students were at a senior level - thus it is felt that the single teacher effect would be moderated by the students' previous experience of many teachers.

CHAPTER 5

RESULTS

5.1 Introduction

This chapter presents the interview results, statistical results from student questionnaire, and an analysis of the open-ended questions in the student questionnaire. Overall interpretation of these results are discussed in more detail in the following chapter. The statistical program SAS was used for analysis of the student questionnaire data. The t-test procedure was used to determine statistically significant differences between country group means on attitudinal and beliefs scores and differences within and between each country males and females scores.

5.2 The Student Interview Results

Before constructing the questionnaire statements, the researcher conducted preliminary interviews in Indonesia. The interviews were held in a secondary general high school in Jakarta. Four male (S1, S3, S5, and S7) and 4 females (S2, S4, S6, and S8) students, age 16-18 years, were randomly selected from five classes of second-grade (year 11) students to participate individually in a structured interview session. Questions (Appendix A7) were designed to explore students' affective reactions to their mathematics education experiences. Interviews, of approximately 40 minutes, were taped and later transcribed for analysis. The following discussion presents an analysis of responses from the interview questions.

* When subjects were asked **"How do you feel about mathematics?"** 50% of them defined maths primarily in terms of **arithmetic computation and inferred that doing problems means**

following rules. One student's (S7) thoughts about maths focused on correctness of performance and level of difficulty. Two subjects indicated a relationship between mathematics and cognition.

"Maths is really nice. It can train the brain only I think in the near future it is required." (S3)

"It makes me to think more logically, more fast." (S4)

One student (S5) was unable to verbalise any conception of mathematics.

"I personally do not know. Since when I was at grade two Junior High School, I began to have difficulties with maths so I do not know what maths is..."

* **"How do you feel about learning mathematics?"** Responses here were mostly negative indicating general dislike or boredom. Only one student (S3) expressed a positive reaction:

"Nice, I could catch it."

Four of the students included a comment concerning teaching methods in their responses.

"The teaching method is good enough. Also they explain clearly." (S5)

"Teaching is as usual, like in the other school subject. For example, if I do not understand he comes to us and teaches us." (S7)

"I can receive the lesson. Then if she gives an exam, the exam problems are similar to the exercises." (S8)

Student (S4) compared grade two (year 11) and grade one (year 10) methods of teaching mathematics.

"In grade two. I feel his teaching method is not enjoyable/interesting for me. It is not like in grade one. In grade one the teacher is nice, he likes to understand us, so we understand what he teaches. In grade two, Mr. A, I feel he is awkward, so I do not understand. Although I make more effort to concentrate because the teaching method,or maybe for me, it is not matching. I do not understand."

* **"Is it your opinion that mathematics is for people with a special ability?"** All subjects disagreed with this statement. Typically justifications included the relation of student effort to achievement levels.

> *"It depends on the person; their intention to do exercises. Every one can do mathematics if they are **diligent** enough."* (S7)
>
> *"Maybe in basics, although an average students can be like an intelligent student if they are **diligent**." (S2)*

* **"What is the key role of a mathematics teacher in the classroom?"** The teacher was chiefly viewed by students as a helper and guide.

> *"The teacher is important, if we only read the book we do not understand. We must be helped by the teacher." (S3)*
>
> *"She guides us. She could, for example, if we got some difficulties, give assistance." (S4)*

* **"What are the things you do to help you learn mathematics?"** Half of the subjects had a private teacher to help them to learn maths. One student said she would *"ask my friend who understands more than I do." (S4)*
Student (S7) stated that he did not have a private teacher, so he did maths by himself. With talking about specific strategies, two students claimed that it was not important to memorize; six students pointed out is **understanding is important**.

* **"Is it particularly important to you to be good at mathematics (more important than other subjects)? Why/ why not?"** Three students claimed that accountancy, English, or biology are more important than mathematics. Such comments support the curriculum statement (*Departemen Pendidikan dan Kebudayaan*, 1986, p. 2-3) in which mathematics is regarded as

> *"a basic of science, so **all sciences use maths** as a reference. For example, if maths is weak it could affect*

the others subjects automatically."

* Further questions explored students' perception/beliefs about mathematics teaching. When asked to describe typical characteristics/qualities of a good mathematics teacher, the following response are representative of students views:

"At first he has to understand me. The teaching method, his explanation do not require repetition. If we do not understand, we can ask question. It means he will take care of us." (S1)

"If Mr A, he often writes, so Mr. K is better than him. He wrote on the blackboard, then explained, so as well as writing he was explaining, thus I could understand. When a teacher writes I do not understand easily." (S2)

"Basically he understand us. He often goes around to ask everybody if we understand or not, then he explains until we understand." (S3)

"At first I like my teacher. For example, my teacher is fascinating to me. He understand us. He knows when we must get a joke, when we must be serious; he can handle us. For example, if the teacher is unskilled and if I feel he is unskilled then I do not understand the maths and I would be too lazy to study." (S4)

"Yes, good teachers give clear explanation and give variation from the routine such as a joke. I mean, they do not force learning, also give a joke." (S5)

"Good teaching is not to be forceful, basically relaxed, but still serious." (S6)

"Good teaching is not going too fast. Our teacher usually gives us an exercise, but before the students finish the teacher gives the answer by herself...then the students copy. It makes it difficult to do because I only look at her." (S7)

* **"What are the key characteristics/qualities of those whom we think are not good mathematics teachers?"** Responses to this question included affective factors. Three of eight

subjects suggested that their teachers get angry or emotional.

"It is not good teaching if he gets emotional too fast, gets angry quickly. If we are noisy, the teacher tends to get angry. As a result we do not care about his subject, it causes laziness. He never gives me exercises, suddenly we get an exam before he knows whether we understand or not." (S1)

S3 complained about specific teaching methods in addition to comments about the exam.

"The explanation is very different, the sound is not clear, and if she gives an exam it is very different to the examples she has already explained."

Also S4 comments on the managerial skills of her teacher.

"When entering the class he feels scared, nervous, ...yes, he cannot handle the class, is awkward, and it effects us. For a long time it makes us lazy."

* **"Do you agree that during the maths lesson you can put forward your own questions and problems?"** Despite concerns about present teaching most students responded positively towards questions concerning their likelihood of influencing their classroom learning environment. Similar positive responses to the question **"Have your teachers encouraged to you to solve problems as independently as possible?"** were given by most students.

* Four of the respondents agreed that mathematics teaching in their classroom stimulate them to learn more mathematics, but other students had reservations.

"The teaching stimulates me, but sometimes if it is studied again it makes me confused, too." (S2)

"But I take a non-scholastic course (a private teacher) so the explanation of the teacher in class would be continued by my private teacher." (S4)

"It depends upon if I can catch it. I would like to do more, I would pay attention, but if I feel it is too

difficult I would be too lazy to do it." (S7)

* When questioned about their beliefs about success and failure in mathematics, the following question: **"Do you think that you have to work hard to do well in mathematics?"**, elicited five affirmative responses. The reasons given for the need to **work hard** included: subject difficulty; inattentiveness; lack of understanding or aptitude for mathematics; and the desire to do very well.
Only one student (S3) regarded mathematics as easy and the other remaining two were cautiously neutral.

> *"It depends on a subject material. If a particular section is difficult and I would worried about failing, then I have to work extra hard."*

* In a related question, seven of the eight students agreed that achievement in mathematics depends on diligence. S4's response is typical:

> *"If one is diligent, and perseveres, they can do it. For example, if the smart one is not diligent, maybe they would not understand it.* ***Diligence, perseverance,*** *then* ***the brain,*** *it can help too, it means it's easy to catch on." (S4)*

Partial disagreement was expressed only by S5, who attributed success in a large part to the teacher:

> *"I think also from the teacher factor, if the teacher gives a good explanation and I receive it..."*

* The interviews also explored factors in the students' environment outside of the classroom, which may influence the nature of beliefs and attitudes, such as parental expectation and help-seeking strategies. There was minimal response concerning parental expectations; all students agreed that they are achieving to their parents' satisfaction. More than half of subjects reported encouragement by their mother or both of their parents, one of them by an older brother.

* **"If you failure to understand the maths, what would you do?"** The most frequent strategy is help seeking from others or themselves. Many included help from private tutors or peers, but students noted the requirement that peers must be more knowledgable.

> *"I try to ask to my friend and try to read the book again." (S1)*
> *"I ask my friends who understand it, or my older brothers." (S2)*
> *"Usually, I try hard if I do not understand, then I ask to my friend who is smarter than me." (S3)*
> *"Usually, I ask my friend and during an addition course I ask my private teacher." (S4)*
> *"I ask my friend who is smarter than me." (S6)*
> *"If I am confused I ask my friends, then I hope the teacher comes to me. I ask him if he would like to explain it to me again." (S7)*

* Questions about homework strategies gave an indication of students' beliefs about mathematics learning and help seeking in particular. **"How long do you spend on homework problems before you give up?"** Students indicated a range of beliefs and available strategies. It is notable in many responses that affective factors related to tiredness, boredom, or physical well-being directly influenced strategy choice and effectiveness.

> *"We are given an example. We can do one exercise, if we can do one exercise we can do another problem. Yes, it depends on the problem. I do not usually worry how long I must spend, but if I get stuck maybe one hour." (S1)*
> *"At first, I do the easy problems and then if I get stuck at home ask my friend at school tomorrow." (S2)*
> *"Usually if I try some first, then I do a lot of problems; maybe I need an hour. But if I have got a headache already I would go to watch the television instead." (S3)*
> *"It depends on myself, I mean if I am in the mood I can*

do nicely, and on the reverse side if I am being lazy I cannot do anything." (S4)
"Four, five minutes, I also am not focusing on it." (S6)
"Yes, it is not a long time only ten minutes. I keep at it, then I will ask for help." (S8)

* When stuck, specific strategies included:
"Take a rest. If I am doing it at home I take a rest then tomorrow at school I will ask to my friend." (S1)
"At first I ask my friend, maybe my brother or sister, and maybe my teacher, too." (S2)
"Usually I ask my friend how to do it." (S3)
"I ask my private teacher." (S5)
"I do nothing until I ask my teacher." (S6)
"It is difficult, I am usually too lazy to do it at home. I would do it at school then." (S7)

* In questioning students about gender issues, four of the students responded *"no" (S1, S2, S6, S8) to the statement,* "men can do better than women in mathematics"; quarter responsed *"same" (S3, S7)*, and the remainder agreed *"women are better than men." (S4, S5)*.

In summary the interview students represented mathematics by computation. Doing mathematics means following rules; although learning mathematics involved understanding rather than memorization. They believed that they had to be diligent and work hard in mathematics learning. For some of student, mathematics is not important: more important subjects are accountancy, English, and biology.

According to their views about mathematics teaching teachers are supposed to spend class time explaining or covering material from the textbook. If a teacher covers material sufficiently well, students should be able to quickly and easily produce correct answers for homework and test problems. Teachers verify that students have received knowledge by checking answers to make sure they are correct.

5.3 The Teacher Results

5.3.1 Indonesian Teacher Interview Results

Two mathematics teachers (one male (M) and one female (F)) were interviewed in Jakarta, prior to questionnaire distribution.

* According to you, **what is the maths?**

F *A subject to train the students, or ourselves to think in **order, logic**, develop skills, with the result that it **can be used in other sciences or in everyday life**.*

M *Maths is the **language of science**. It can relate to several sciences and it also can build the other sciences, for example, physics, chemistry.*

I *Do you mean, a tool for the other science.*

M *Yes...*

These beliefs reflect to the mathematics curriculum (*Departemen Pendidikan dan Kebudayaan*, 1986) statements concerning the nature of mathematics.

* **What is the role of memorization in mathematics?**

F *For the basics, **memorization is important**. My experience in Primary School, a long time ago, suggests I must memorize arithmetic. Today times are changed: we use the new maths which uses set theory as a foundation; several approaches use process skills, and in arithmetic it is not necessary to memorize for several years. But now we get many students who are weak in arithmetic, and not the strongest in the mastering of maths.*

I *So, is it important, Mam?*

F *Yes, it is fundamental to memorize arithmetic in Primary School,..it is important.*

Similarly, M places great importance on memorization, but also notes the importance of deriving formulae.

M *There are some important things to memorize and there others that are not. For example,* ***it is important to memorize the formulae.*** *We have to memorize these, without it we cannot do maths, but we must know where formulae come from.*

* **Do you believe that to be successful in maths, the students have to do work hard?**

F *Yes...**working hard, diligence, and perseverance are important**.*

I *Do you believe, that in maths learning we need a special ability or can people with average intelligence learn maths?*

F *If..the children have a special ability they can always do it. But if only average, the teacher must give more **stimulation and motivation**.*

M *One of...it must be necessary to **work hard**.*

I *Does learning maths require a special ability, or can people with average intelligence do well?*

M *Ability in maths affects how fast or slow students learn. There are differences. Some students only need the material once and they understand and can do it. Other students need to do it twice, or three times. I think most average students can do maths but they need more time. So intelligence has an effect, but not directly.*

When further questioned on achievement and ability distinct gender differences were noted by both teachers.

* **Do you prefer teaching male or female students maths?**

F *This depend on the level..I mean if it still at SD (Primary), SMP (Junior Secondary), I prefer females because females are more diligent, and persevere. As a result they stand out among the class. But if in SMA,* *males are smarter, even if they are not persevering their results are still good.*

I *Are there any differences in subject areas between males and females?*

F *According to me,* ***males are better in doing geometry than females****. Males are more fast to catch it. However, in algebra and memorization, females are more superior than males.*

M *At the present time, the trend is* ***for female students*** *to persevere more. From this perseverance their results are often better.*

It is clear that success by females was attributed to hard work and effort, whereas success by males was due to natural ability in mathematics. The perceived relationship between effort and achievement differences due to natural ability and learning styles was reinforced in the following responses concerning teaching.

* **What do you do to improve performance of your students?**

F *According to me, the basic knowledge is revised and built on. There is* ***a lot of doing exercises****, skills; doing a lot of exercises improves performance. Then an evaluation. It is important to evaluate in order, and close to the time - one topic is evaluated then the further topic, but still do not leave the first one. The evaluation is like a spiral and it can increase the students' results.*

I *How can you stimulate your students to succeed?*

F ***Make them to like it****. In my experience at SMA I give exercises, then if they do them all and finish on time, I like to give them a bonus. The exercises are not too much, only a few, but it is essential, it makes the students more enthusiastic. It is important that the methods are not a monotonous sequence. According to me, multi-methods are better. My experience in teaching* *secondary level suggests that doing exercises..., one day I give a method like "fast and accurate"; I divided groups in the class and allocated them different topics to study. For example, three dimensional work like the cube involves memorization, recall and revision.*

M *I use a different approaches for different types of students; physics, biology and social sciences students. For the physics students, we can get to the point because they are required to do sciences. For biology students, I will decrease the material; we use a different approach. For example, in physics it is rather relax but in biology is not. For social sciences it is more persuasive. We have to more persuasive, hold back, and go more slowly so that it can decrease the trend (the trend that social sciences students do not like maths anymore). We as maths teacher have to be more careful to encourage students to like maths more.*

I *How can you stimulate the children so that they like maths?*

M *In my experience biology students and most social sciences students need* **stimulation**. *In our approach we do not use classical methods because if we use the classical methods the results are not good enough. We need an individual approach. To approach student one -by - one. We try and we anticipate weaknesses. This method is more time consuming, but I think it is better than having students who do not understand. It is indeed so long..a long time is needed to do it properly. Never mind, it is important if I get a result.*

In summary, these two teachers view mathematics as a set of material to train the brain to think logically, and as a tool of science. The roles of memorization in mathematics is important, especially in the primary school. They also believe that to be good in mathematics students need to work hard and persevere in their studies: Special ability is not an exclusive requirement to do well in mathematics. However, they do suggest the use of different teaching methods according to class groupings.

With regard to gender, both teachers feel that female students exhibit preferable work skills of perseverance and consequently achieve high results, especially in the junior school. There is preference towards male students in secondary senior high school; the female teacher suggesting that the natural ability of males tends to compensate for lack of effort.

The female teacher's attempts to motivate student seem grounded in a view of mathematics prevalent in Indonesian culture: mathematics is hard and boring; to interest students, teachers must dress mathematics up, make it exiting, interesting, and engaging. Both acknowledged the need to attend to the affective issues when motivating students to study and persevere with mathematics.

5.3.2 Comparison between New Zealand and Indonesian Teachers

Data for New Zealand teachers was from an earlier study (Walshaw, 1994) which examined curriculum implementation. Walshaw collected responses from thirteen secondary school mathematics teachers. These teachers were four secondary schools based in the same region as the New Zealand students in the present study. From Indonesia, the researcher sampled eight mathematics teachers from two secondary general schools, one of which was common with the sample students' school.

Table 5.1 presents a summary of teachers' current teaching practices.

Table 5.1 Ratings of teacher behaviour frequency (and percentage frequency) for New Zealand and Indonesia

Scale Dimension	NZL			INA		
Teaching mathematics with my class currently involves:	**N**	**S**	**M**	**N**	**S**	**M**
1. Teacher led discussion	0	8 61.54	**5** 38.46	0	**8** 100	0
2. Teacher demonstration	0	**11** 84.62	**2** 15.38	0	**8** 100	0
3. Teacher explanations	**0**	6 46.15	**7** 53.85	**3** 37.5	5 62.5	**0**
4. Media presentations	1 7.69	12 92.31	0	2 25	6 75	0
5. Guest speakers	**11** 84.62	**2** 15.38	0	**8** 100	**0**	0
6. Teacher-initiated investigations	**0**	11 84.62	2 15.38	**2** 25	5 62.5	1 12.5
7. Students doing self-initiated investigations	1 7.69	12 92.31	**0**	1 12.5	6 75	**1** 12.5
8. Exploring how ideas fit	**0**	11 84.62	2 15.38	**1** 12.5	4 50	3 37.5
9. Students discussing in small group	1 7.69	11 84.62	1 7.69	1 12.5	6 75	1 12.5
10. Students discussing as a class	0	10 76.92	**3** 23.08	0	8 100	**0**
11. Students doing written task sheets	0	11 84.62	2 15.38	1 12.5	5 62.5	2 25
12. Students writing mathematics in their own words	1 7.69	9 69.23	3 23.08	0	6 75	2 25
13. Students consulting magazines and books for reference	2 15.38	11 84.62	0	3 37.5	5 62.5	0

Table 5.1 continues

Scale Dimension	**NZL**			**INA**		
Teaching mathematics with my class currently involves:	**N**	**S**	**M**	**N**	**S**	**M**
14. Mathematics projects, display work, or making posters	1 7.69	12 92.31	0	5 62.5	3 37.5	0
15. Field trips and visits	6 46.15	7 53.95	0	8 100	0	0
16. Students tackling new challenges	0	12 92.31	1 7.69	0	3 37.5	5 62.5
17. Students exploring pitfalls and misconceptions	1 7.69	12 92.31	0	1 12.5	6 75	1 12.5

Notes:

1. **NZL is New Zealand and INA is Indonesia**
2. **N is never, S is sometimes, and M is mostly**

In New Zealand, Walshaw (1994) found that mathematics teaching emphasized:

> ...teacher led discussion and teacher explanations, and sometimes involved teacher demonstration, teacher-initiated investigations, task, sheets, and media presentations, together with learner-centred activities of small group and class discussion, projects, new challenges, student-worded mathematics, exploration of ideas, pitfalls and misconceptions, consultation with reference sources, and student initiated investigations. (Walshaw, 1994, p. 16).

While the number of teachers in the Indonesia sample is small, there appears to be some apparent differences in reported teaching approaches. The use of discussion work involving students appears to be less common than in the New

Zealand sample. Alternative such as guest speakers, project and display work and field trips are rarely used in Indonesian classrooms.

The results of the questionnaire on teachers beliefs about learning mathematics are presented in Table 5.2. In responding to beliefs about learning mathematics, Walshaw (1994, p. 21) noted that New Zealand teachers "considered that learning was mostly helped by students asking questions and by testing out their own ideas, and drawing and justifying conclusions." It can be seen, however, that teachers believed that learning was sometimes helped by a range of practices: students listening to the teacher explanations, note taking, exam practice, textbook reading and exercises, watching a teacher work through a problem, working out practical problems, group discussions, investigations, reading non-text books, talking and listening to experts, solving puzzles and games, reflecting on ideas, and evaluating learning.

In marked contrast, Indonesian mathematics teachers' beliefs about mathematics learning strongly emphasized students listening to the teacher explaining, taking good notes to revise from, reading text-books, doing written exercises from text-books, watching a teacher work through a problem, working out practical problems, and provision of opportunities for students to practice exam/test questions. While New Zealand teachers supported a wide range of learning activities several Indonesian teachers believed that students gained little from testing their own ideas, using puzzles and games and investigations or self evaluating their work. In general their views of learning supported teacher directed student work.

Table 5.2 Ratings of mathematics learning beliefs for New Zealand and Indonesia

Scale Dimension	NZL			INA		
In my experience, learning mathematics is helped by:	**N**	**S**	**M**	**N**	**S**	**M**
1. Students listening to the teacher explaining	1 7.69	**9** **69.23**	3 23.08	0	0	**8** 100
2. Students taking good notes to revise from	1 7.69	**11** 84.62	1 7.69	0	2 25	**6** 75
3. Opportunities for students to practice exam/test questions	1 7.69	**11** 84.62	1 7.69	0	1 12.5	**7** 87.5
4. Students reading text-books	2 15.38	**11** 84.62	0	0	3 37.5	**5** 62.5
5. Students doing written exercises from text-books	0	**13** 100	0	0	2 25	**6** 75
6. Students watching a teacher work through a problem	0	**12** 92.31	1 7.69	0	1 12.5	**7** 87.5
7. Students working out practical problems	0	**9** 69.23	4 30.77	0	1 12.5	**7** 87.5
8. Students talking and listening to other students in groups	1 7.69	7 53.95	5 38.46	0	6 75	2 25
9. Students asking questions	0	3 23.08	10 79.92	0	3 37.5	5 62.5
10. Students carrying out investigations	0	8 61.54	5 38.46	3 37.5	3 37.5	2 25
11. Students tinkering around with equipment	1 7.69	10 79.93	2 15.38	2 25	6 75	0

Table 5.2 continues

Scale Dimension	NZL			INA		
In my experience, learning mathematics is helped by:	**N**	**S**	**M**	**N**	**S**	**M**
12. Students reading books (apart from text-books)	2 15.38	10 79.93	1 6.79	0	5 62.5	3 37.5
13. Students talking and listening to experts	1 7.69	12 92.31	0	5 62.5	2 25	1 12.5
14. Students browsing in the library	1 7.69	12 92.31	0	1 12.5	5 62.5	2 25
15. Students testing out their own ideas	0	5 38.46	8 61.54	1 12.5	4 50	3 37.5
16. Students solving puzzles and games	0	9 69.23	4 30.77	2 25	5 62.5	1 12.5
17. Students reflecting on their own ideas	0	7 53.85	6 46.15	2 25	5 62.5	1 1.25
18. Students evaluating what they have learnt	0	7 53.85	6 46.15	2 25	2 25	4 50
19. Students examining misconceptions and confusions	0	8 61.54	5 38.46	1 12.5	3 37.5	4 50
20. Students drawing and justifying conclusions	0	6 26.15	7 53.85	0	4 50	4 50

Notes:

1. **NZL is New Zealand and INA is Indonesia**

2. **N is never, S is sometimes, and M is mostly**

In the third questionnaire teachers were asked to indicate the emphasis they gave to each of a list objectives relative to the others, by choosing responses 'relatively more emphasis', 'about equal emphasis', 'relatively less emphasis'. Table 5.3 compares New Zealand and Indonesia teachers' responses.

Walshaw (1994, p. 23) found that New Zealand teachers "assigned a higher importance to those objectives which developed mathematical concepts rather than specific procedures." Their perceptions reflects a growing awareness of constructivist approaches advocated in the present curriculum document (Ministry of Education, 1992). Specifically, New Zealand teachers attributed the development of an attitude of enquiry as more important than any other objective and placed a strong emphasis on problem solving. Altogether, the results reflect an increased emphasis on the solution of complex problems, in deference to the development of greater computation skills.

Indonesian teachers, in contrast, emphasized the development of an awareness of the importance of mathematics in everyday life. Also Indonesian teachers placed more emphasise on understanding the logical structure of mathematics, knowledge of mathematical facts, principles and algorithms, the understanding the nature of proof and the development of computational speed and accuracy.

Table 5.3 Objectives of mathematics teaching as assigned by percentage weightings for New Zealand and Indonesia

Scale Dimension	New Zealand			Indonesia		
Teachers' Objectives the Teaching of Mathematics	**More**	**Equal**	**Less**	**More**	**Equal**	**Less**
Develop an awareness of the importance of mathematics in everyday life.	**61.5**	38.5	0	**87.5**	12.5	0
Understand the logical structure of mathematics	15.4	**69.2**	15.4	37.5	**62.5**	0
Develop an awareness of important of mathematics in the basic and applied sciences	30.8	**53.8**	15.4	**75**	25	0
Develop an attitude of enquiry	**100**	0	0	**62.5**	25	12.5
Develop a systematic approach to solving problems	**76.9**	23.1	0	**75**	25	0
Develop an interest in mathematics	38.5	61.5	0	62.5	37.5	0
Know mathematical facts, principles and algorithms	0	69.2	30.8	12.5	87.5	0
Understand the nature of proof	0	53.8	46.2	12.5	87.5	0
Perform computation with speed and accuracy	7.7	61.5	30.8	50	50	0

Teachers from New Zealand (Walshaw, 1994) and Indonesia were asked to indicate the extent of current use of specific resources (Table 5.4). Walshaw (1994) found that teachers in New Zealand are beginning to create environments conducive to students' thinking about mathematics; they select instructional materials and activities to encourage students' learning and engage students in a discourse which enhances their mathematical learning. Indonesian teachers more often use text-books, self-prepared tests, and self-prepared teaching materials than New Zealand teachers.

Table 5.4 Resources as denoted by percentage use for New Zealand and Indonesia

Scale Dimension	New Zealand			Indonesia		
Resource Used by Teachers	Often	Sometimes	**Never**	Often	Sometimes	**Never**
Textbooks	**61.5**	30.8	7.7	**100**	0	0
Self-prepared tests	**69.2**	30.8	0	**100**	0	0
Self-prepared teaching materials	**69.2**	30.8	0	**100**	0	0
Published workbooks or problem sets	23.1	**76.9**	0	12.5	**75**	12.5
Individualised materials	23.1	**53.8**	23.1	12.5	**75**	12.5
Commercially published tests	0	**53.8**	46.2	0	0	**100**
Commercially produced visual materials	7.7	**84.6**	7.7	0	0	**100**

5.4 The Statistical Results

5.4.1 Comparisons on Categories of Attitudinal and Beliefs Scores

Descriptive statistic were calculated using a t-test procedure (SAS Institute Inc., 1990; Spector, 1993). The independent variables were grouped (as country) and subgroups (as gender), with scores on the attitudinal and beliefs scales used as the dependent variables.

Table 5.5 shows the mean scores, standard deviations, and t-test coefficient of attitudinal and beliefs categories scores for New Zealand and Indonesian students.

Comparison of the mean scores by t-test shows significant differences in both attitudinal scores of enjoyment of mathematics ($p < 0.06$) and value (perceive usefulness) of mathematics ($p < 0.001$). In both cases scores for Indonesian students were higher (representing a more positive attitude) than New Zealand students.

Three of six belief scores were found to be very significant: beliefs about mathematics ($p < 0.001$), beliefs about mathematics learning ($p < 0.000$), and beliefs about home support ($p < 0.03$ level). Again differences reflected the higher scores by Indonesian students. What was interesting, and maybe surprising, was the absence of a significant difference in beliefs about mathematics teaching. Surprising because of differences in curriculum aims and teacher perceptions (Section 1.1 and 5.3).

Table 5.5 Means, standard deviation, and t-test results for all categories by country

Category	New Zealand	Indonesia	t & p value
Enjoyment of maths means sd (n)	 12.638 2.151 (47)	 13.348 2.281 (184)	 -1.9251 p < 0.056 #
Value of maths means sd (n)	 28.156 4.441 (45)	 30.629 3.969 (186)	 -3.6631 p < 0.001 #
Beliefs about maths means sd (n)	 8.170 1.798 (47)	 9.309 1.736 (191)	 -3.9999 p < 0.001 #
Beliefs about self as learners means sd (n)	 36.404 5.652 (47)	 37.381 3.951 (189)	 -1.3813 p < 0.169
Attribution means sd (n)	 19.255 2.549 (47)	 19.032 2.361 (189)	 0.5718 p < 0.568
Beliefs about maths learning means sd (n)	 30.369 3.574 (46)	 33.358 3.638 (190)	 -5. 0155 p < 0.000 #
Home support means sd (n)	 13.522 3.284 (46)	 14.487 2.529 (191)	 -2.1842 p < 0.029 #
Beliefs about maths teaching means sd (n)	 93.170 10.750 (47)	 92.596 8.123 (183)	 0.4031 p < 0.687

Notes:

1. Maximum ratings/score possible
* attitude toward enjoyment of maths (items 1-4) is 20,
* attitude toward value of maths (items 5-12) is 40,
* belief about maths (items 13-15) is 15,
* belief about self (items 16-26) is 55,
* attribution (items 27-32) is 30,
* belief about maths learning (items 33-43) is 55,
* belief about home support (items 44-47) is 20, and
* belief about maths teaching (items 48-70) is 115.

2. # indicates significant differences.

Table 5.6 and 5.7 indicate the mean scores, standard deviations, and t-test coefficient of attitudinal and beliefs scores within each country for males and female students. T-test comparisons of the mean scores indicates a significant gender difference in only a few of beliefs categories scores and no significant differences in attitudinal categories scores. Within New Zealand, significant gender differences were found in beliefs about mathematics learning ($p < 0.03$) and beliefs about mathematics teaching ($p < 0.01$). Indonesian students, however, showed no significant gender differences in response to attitudinal and beliefs categories scores. Thus overall student views appear to contrast the strong gender related responses of interview teachers. Additionally, it is noted that **differences between countries were greater than gender differences within countries.**

Table 5.6 Means, standard deviation, and t-test results for all categories by gender for New Zealand

Category	Male	Female	t & p value
Enjoyment of maths means sd (n)	 12.652 2.187 (23)	 12.625 2.163 (24)	 0.0428 p < 0.966
Value of maths means sd (n)	 28.047 4.141 (21)	 28.250 4.775 (24)	 -0.1508 p < 0.881
Beliefs about maths means sd (n)	 8.261 2.049 (23)	 8.083 1.558 (24)	 0.3352 p < 0.739
Beliefs about self as learners means sd (n)	 35.522 5.861 (23)	 37.250 5.431 (24)	 -1.0491 p < 0.299
Attribution means sd (n)	 18.696 2.420 (23)	 19.792 2.604 (24)	 -0.4930 p < 0.142
Beliefs about maths learning means sd (n)	 29.217 3.162 (23)	 31.522 3.654 (23)	 -2.2871 p < 0.027 **#**
Home support means sd (n)	 13.478 3.088 (23)	 13.565 3.539 (23)	 -0.0888 p < 0.929
Beliefs about maths teaching means sd (n)	 89.261 12.348 (23)	 96.917 7.442 (24)	 -2.5871 p < 0.013 **#**

Notes:

1. Maximum ratings/score possible

* attitude toward enjoyment of maths (items 1-4) is 20,
* attitude toward value of maths (items 5-12) is 40,
* belief about maths (items 13-15) is 15,
* belief about self (items 16-26) is 55,
* attribution (items 27-32) is 30,
* belief about maths learning (items 33-43) is 55,
* belief about home support (items 44-47) is 20, and
* belief about maths teaching (items 48-70) is 115.

2. **#** indicates significant differences.

Table 5.7 Means, standard deviation, and t-test results for all categories by gender for Indonesia

Category	Male	Female	t & p value
Enjoyment of maths means sd (n)	 13.614 2.274 (88)	 13.104 2.269 (96)	 1.5191 p < 0.131
Value of maths means sd (n)	 31.124 3.765 (89)	 30.175 4.116 (97)	 1.6349 p < 0.104
Beliefs about maths means sd (n)	 9.489 1.884 (92)	 9.141 1.578 (99)	 1.3863 p < 0.167
Beliefs about self as learners means sd (n)	 37.912 4.289 (91)	 36.888 3.561 (98)	 1.7914 p < 0.075
Attribution means sd (n)	 19.209 2.579 (91)	 18.967 2.138 (98)	 0.9934 p < 0.322
Beliefs about maths learning means sd (n)	 33.615 3.666 (91)	 33.121 3.615 (99)	 0.9350 p < 0.351
Home support means sd (n)	 14.761 2.456 (92)	 14.232 2.583 (99)	 1.4471 p < 0.149
Beliefs about maths teaching means sd (n)	 91.847 8.104 (85)	 93.245 8.125 (98)	 -1.1621 p < 0.247

Notes:

1. Maximum ratings/score possible

* attitude toward enjoyment of maths (items 1-4) is 20,
* attitude toward value of maths (items 5-12) is 40,
* belief about maths (items 13-15) is 15,
* belief about self (items 16-26) is 55,
* attribution (items 27-32) is 30,
* belief about maths learning (items 33-43) is 55,
* belief about home support (items 44-47) is 20, and
* belief about maths teaching (items 48-70) is 115.

2. # indicates significant differences.

5.4.2 Comparisons on Every Single Item

Single items, in terms of the cross-national study, were compared using t-test. As shown in Table 5.8, thirty-four of the seventy items differed significantly between countries. Indonesian students scored significantly higher than New Zealand students on the following categories and items.

*** Enjoyment of mathematics:**

Significant differences on Q1 indicated that Indonesian students find maths more enjoyable and stimulating than their New Zealand counterparts. However, Indonesian students show only slight, agreement and New zealand students slight disagreement with the item.

*** Value (perceive usefulness) of mathematics:**

The responses to individual questions indicate that Indonesian students, more strongly than New Zealand students, believe that mathematics is required to study other subjects (Indonesian means is 4.027 compared with New Zealand means is 3.674), and that mathematics is important in everyday life, especially for jobs. New Zealand students, while showing similar agreement to their Indonesian counterparts with regard to the importance of mathematics for their country's development, feel more strongly that mathematics will help them get a job. This belief reflects the demand high level mathematics qualifications to enter careers such as the air force, teacher education, apprenticeships and nursing in New Zealand.

*** Beliefs about mathematics:**

Students' responses indicated no significant differences with regard to the abstractness and complexity of the discipline. However, Indonesian students disagreed significantly more than New Zealand in the more authoritative rights/wrong approach of answers. On a negative scoring, Indonesian mean of 3.194 compared with New Zealand mean of 2.489. Indonesian students also believe more strongly that mathematics helps them to think clearly and logically.

*** Beliefs about themselves as learners:**

Indonesian students responses showed a strong belief in the value of self-directed hard work (Q18 and Q25). Their more positive responses to the statement: "Being good at mathematics is important for me", may provide some explanation of the effort and motivation expressed in student interviews. However, Indonesian students agreed significantly more strongly than New Zealand counterparts that they felt nervous when solving problems (3.085 [New Zealand] against 2.805 [Indonesia]).

*** Attribution to success and failure in mathematics learning:**

It was surprising, given Indonesian students' expressed belief in self-directed hard work that overall attributions were very similar between the two countries. Also surprising was Indonesian students higher attribution of success to natural ability than New Zealand students. However, despite a significant difference, agreement of this statement was only slightly above neutral (mean 3.055).

*** Beliefs about mathematics learning:**

Overall, Indonesian students disagreed more strongly than New Zealand counterparts that mathematics learning is more difficult (2.749 against 2.447) and mathematics lessons are more boring (3.194 against 2.468). Indonesian students expressed higher disagreement to feeling nervous when asked questions in class (3.031 against 2.426). Indonesian are also more likely to be disappointed if they miss a lesson. This could be seen to be consistent with the high value Indonesian students place on mathematics and their more positive enjoyment and perhaps explains their willingness and acceptance of hard work. In support of differences in teaching approaches (section 5.3) New Zealand students felt significantly more positive about discussions than did Indonesian students.

*** Beliefs about home support:**

Cultural differences are especially evident in responses to home support. While there were no differences in perceived general encouragement, specific support by either family or tutor are more likely in Indonesia. This availability of support is consistent with the belief by Indonesian students that parents expect them to do well in mathematics.

*** Beliefs about mathematics teaching:**

Eight of eleven items supported by New Zealand students overall related to their beliefs about mathematics teaching. It appears that New Zealand students put much more emphasis on the teacher to assist learning rather than taking responsibility for their own learning. Indonesian students disagreed significantly more than New Zealand students that "A good maths teacher often moves onto a new topic before I really understand the old one" and that "A good maths teacher covers all the material in this course, even if the students do not understand it all". Thus Indonesian students are more comfortable with the rate of course coverage in relation to their understanding, than New Zealand students.

Table 5.8 T-test results for all items by country

No.	Category and Items	NZL mean	INA mean	p <	by
	Enjoyment of Mathematics				
1. +	Mathematics is enjoyable and stimulating to me.	2.659	3.142	0.001	**INA**
2. -	I have never liked mathematics.	3.596	3.576		
3. +	Doing well in maths is more important to me than enjoying the subject.	3.319	3.385		
4. -	Mathematics makes me feel uneasy and confused.	3.067	3.207		
	Value (perceive usefulness) of mathematics				
5. +	Mathematics is required to study other subjects.	3.674	4.027	0.007	**INA**
6. -	Mathematics is not important in everyday life.	3.851	4.052		
7. +	If I know mathematics, it will help me to get a job.	4.128	3.719	0.002	**NZL**
8. -	A lot of the maths I learn in school I will never use later on.	2.426	3.989	0.000	**INA**
9. +	Mathematics will become even more important to everyday life in the future.	3.404	3.659	0.060	**INA**
10. +	Mathematics is of great importance to a country's development.	3.596	3.791		
11. +	In the near future most jobs will require a knowledge of advanced mathematics.	3.468	3.921	0.001	**INA**
12. -	Outside of science and engineering, there is little need for mathematics in most jobs.	3.565	2.659		
	Beliefs about maths				
13. -	Mathematics is too abstract and very complicated.	2.766	2.659		
14. +	Mathematics helps me to think clearly and logically.	2.915	3.455	0.001	**INA**

Table 5.8 continues

No.	Category and Items	NZL mean	INA mean	p <	by
15. -	**Beliefs about Mathematics** Unlike most other subjects, in maths the answers are either right or wrong.	2.489	3.194	0.000	**INA**
16. +	**Beliefs about Themselves as Learners** I am very good at mathematics.	2.766	2.759		
17. -	I have no talent for mathematics.	3.255	3.242		
18. +	My maths marks would be better if I worked harder.	4.000	4.272	0.024	**INA**
19. -	Luck often determines the marks in my mathematics test.	3.511	3.429		
20. +	Being good at mathematics is important for me.	3.340	3.942	0.000	**INA**
21. -	I always feel nervous when I look at a maths problem.	3.085	2.805	0.051	**NZL**
22. +	To get good marks I have to work hard in mathematics.	4.106	4.021		
23. -	No matter how much I try I have problems learning mathematics.	3.043	2.801		
24. +	I prefer to discover things for myself in mathematics rather than be told.	2.979	3.219		
25. +	I can learn better and remember something for longer if I have to discover it for myself.	3.383	3.785	0.003	**INA**
26. +	I am as talented in maths as other students in my class.	2.936	3.068		
27. +	**Attribution to Success and Failure in Maths Learning** If I work carefully I can usually do most of my maths problems.	3.659	3.728		
28. +	If I do well in maths, it is usually because I am naturally very good at maths.	2.766	3.055	0.012	**INA**

Table 5.8 continues

No.	Category and Items	NZL mean	INA mean	p <	by
29. +	If I do well in maths, it is usually because I have a good teacher.	3.468	3.236		
30. -	If I do badly in maths it is usually because I am hope-less at it.	3.383	3.236		
31. -	If I do badly in maths it is usually because I did not try hard enough.	2.213	2.136		
32. -	If I do badly in maths it is usually because I was unlucky.	3.766	3.670		
33. +	**Beliefs about Maths Learning** I am disappointed when I miss a maths lesson.	2.170	3.141	0.000	**INA**
34. -	Mathematics lessons are bor-ing.	2.468	3.194	0.000	**INA**
35. +	I prefer to work on my own rather than in groups.	2.808	2.817		
36. -	Mathematics is more than just calculating answers.	2.340	2.219		
37. +	Homework problems are good for practice of work in class.	3.298	3.532		
38. -	Learning mathematics is more difficult than another sub-jects.	2.447	2.749	0.057	**INA**
39. +	Learning mathematics is helped by lots of discussion and questions during the lesson.	3.894	3.560	0.014	**NZL**
40. -	Learning mathematics involves mostly facts and procedures that have to imi-tated.	2.587	2.728		
41. +	I can learn about maths in school, but rarely use it outside of school.	2.936	3.052		
42. -	I am lucky when I do well on maths test.	3.064	3.314		

Table 5.8 continues

No.	Category and Items	NZL mean	INA mean	p <	by
43. -	I feel nervous when I am asked a question in the class.	2.426	3.031	0.000	**INA**
44. +	**Beliefs about Home Support** My parents expect me to do well at maths.	3.630	4.094	0.001	**INA**
45. +	Someone in my family is able to help me with maths home-work.	2.723	3.304	0.001	**INA**
46. +	Someone in my family encour-ages me to learn maths.	3.532	3.544		
47. +	I have a private maths tutor.	1.630	3.242	0.000	**INA**
48. +	**Beliefs about Maths Teaching** **A good maths teacher:** Gives lots of examples which deal with practical situ-ations.	4.085	4.225		
49. +	Is one who encourages me to learn more about mathemat-ics.	4.085	3.942		
50. +	Allows students to put for-ward their own questions and problems in a lesson.	3.979	4.152		
51. +	Makes it clear what I need to do to be successful in a maths lesson.	4.064	4.335	0.004	**INA**
52. +	Gives a lot of notes and summaries.	3.617	2.974	0.000	**NZL**
53. +	Has genuine concern for stu-dent progress.	4.383	4.120	0.021	**NZL**
54. +	Provides feedback that is helpful	4.234	3.832	0.001	**NZL**
55. +	Communicates knowledgeably in this subject.	4.213	3.365	0.000	**NZL**
56. +	Is well organised and comes to class prepared.	4.404	3.885	0.000	**NZL**
57. +	Uses materials, language and examples which include all students (i.e. non-racist, non-sexist, etc.).	4.106	4.131		

Table 5.8 continues

No.	Category and Item A good maths teacher:	NZL mean	INA mean	p <	by
58. +	Gives fair grades.	4.213	4.424	0.052	**INA**
59. +	Shows students lots of different ways to look at the same question.	3.829	4.037		
60. +	Shows you the exact way to answer the maths question you will be tested on.	3.809	3.405	0.023	**NZL**
61. +	Treats all students fairly.	4.277	4.444		
62. +	Shows control in class yet maintains friendly relaxed atmosphere.	4.255	4.445		
63. +	Uses everyday life situations.	4.419	4.010		
64. +	Is enthusiastic.	4.170	3.644	0.001	**NZL**
65. +	Has a sense of humour.	7.085	4.492	0.001	**INA**
66. +	Is patient and considerate.	4.234	4.393		
67. -	Often moves onto a new topic before I really understand the old one.	3.809	4.178	0.012	**INA**
68. +	Wants all students to understand why things happen the way they do.	3.894	3.974		
69. +	Thinks mistakes are OK, as long as students learn from them.	4.149	3.869	0.045	**NZL**
70. -	Covers all the material in this course, even if the students do not understand it all.	3.128	4.169	0.000	**INA**

Notes:

1. + or - indicate positive or negative wording.
2. **NZL is New Zealand and INA is Indonesia.**

5.4.3 Gender-related Differences

When a similar item analysis was done for male and female New Zealand students only six items proved significant (Table 5.9). This is consistent with overall category scores.

Table 5.9 T-test results for significant items by gender for New Zealand

No.	Category and Items	Male mean	Female mean	p <	by
15. -	**Beliefs about maths** Unlike most other subjects, in maths the answers are either right or wrong.	2.783	2.208	0.024	**M**
50. +	**Beliefs about maths teaching. A good maths teacher:** Allows students to put forward their own questions and problems in a lesson.	3.739	4.220	0.049	**F**
58. +	Gives fair grades.	3.957	4.458	0.044	**F**
61. +	Treats all students fairly.	3.956	4.583	0.025	**F**
66. +	Is patient and considerate.	3.957	4.500	0.046	**F**
69. +	Thinks mistakes are OK, as long as students learn from them.	3.826	4.458	0.022	**F**

Notes:
1. + or - indicate positive or negative wording.
2. **M is male and F is female.**

In beliefs about mathematics males showed less support for the statement that in maths the answers are either right or wrong ($p < 0.024$) than females. In the students' beliefs about mathematics teaching all students express strong support for the following items (However, female students agreed significantly more strongly than males):

* A good maths teacher allows students to put forward their own questions and problems in a lesson ($p < 0.05$);
* gives fair grades ($p < 0.04$);

* treats all students fairly ($p < 0.03$);
* is patient and considerate ($p < 0.05$);
* and thinks mistakes are OK, as long as the students learn from them ($p < 0.02$).

Within Indonesian students, eight items from seven categories, had significant differences across gender (Table 5.10). In particular, males enjoyed mathematics (are more disappointed if they miss the lesson) and valued mathematics more than the females. Surprising, and contrary to attribution theories, males were more likely to attribute success to a good teacher. However, in line with attribution theorists, they were more likely to disagree with the statement that they had no talent in mathematics than females. Males also reported significantly more encouragement to learn mathematics from their families. However, females were more likely to have a private tutor.

Further analysis explored the question of where support for individual items is most strong; that is between countries, within New Zealand students, or within Indonesian students. For example, for item "Mathematics is enjoyable and stimulating to me"; we have $p < 0.001$ for among countries, and $p < 0.059$ within Indonesian students. Thus the differences between countries is stronger than gender differences within Indonesian students. There are three further items which are more significant between countries than within Indonesian students: "In the near future most jobs will require a knowledge of advanced mathematics"; ($p < 0.000$ against p , 0.06); "I am disappointed when I miss a maths lesson"; ($p < 0.000$ against $p < 0.048$); and "I have a private maths tutor"; ($p < 0.000$ against $p < 0.007$). That is, despite significant gender differences within Indonesia, the differences between countries is more significant. Within New Zealand students, there are three significant items to compare with between countries differences. "Unlike in most other subjects, in maths the answers are either right or wrong"; ($p < 0.000$ against $p < 0.024$); "A good maths teacher give fair grades"; ($p < 0.052$ against $p < 0.044$); and "A good maths teacher thinks mistakes are OK, as long as the students learn from them"; ($p < 0.045$ against $p < 0.022$). With the first item, stronger disagreement support come from between countries rather than within New Zealand, but with the remaining two items significant differences between gender New Zealand greater than differences between countries.

Table 5.10 T-test results for significant items by gender for Indonesia

No.	Category and Items	Male mean	Female mean	p <	by
1. +	**Enjoyment of Mathematics** Mathematics is enjoyable and stimulating to me.	3.275	3.020	0.059	**M**
11. +	**Value of maths** In the near future most jobs will require a knowledge of advanced mathematics.	4.022	3.828	0.059	**M**
17. -	**Beliefs about self as learners** I have no talent for mathematics.	3.413	3.028	0.002	**M**
29. +	**Attribution** If I do well in maths, it is usually because I have a good teacher.	3.391	3.091	0.013	**M**
33. +	**Beliefs about Maths Learning** I am disappointed when I miss a maths lesson.	3.261	3.030	0.048	**M**
46. +	**Beliefs about home support** Someone in my family encourages me to learn maths.	3.674	3.424	0.047	**M**
47. +	I have a private maths tutor.	2.989	3.475	0.007	**F**
62. +	**Beliefs about maths teaching. A good maths teacher:** Shows control in class yet maintains friendly relaxed atmosphere.	4.315	4.566	0.003	**F**

Notes:
1. + or - indicate positive or negative wording.
2. **M is male and F is female.**

5.4.4 Comparison in Attitudinal and Beliefs Scores for Gender Subgroups

In order to explore the differences in attitudinal and beliefs scores among male and female (New Zealand) and male and female (Indonesia), ANOVA procedures with an unbalanced data size (SAS Institute Inc., 1990a and 1990b) was carried out (Appendix A8).

The results indicate a significant differences in means of attitudinal and beliefs, categorised by value (perceive usefulness) of mathematics ($F = 5.79$, $p < 0.001$), beliefs about mathematics ($F = 6.00$, $p < 0.001$), beliefs about mathematics learning ($F = 10.38$, $P < 0.000$), and beliefs about mathematics teaching ($F = 3.71$, $p < 0.012$).

In order to locate precisely the source of the difference, pairwise comparison was done using Fishers' protected t-test (Appendix A9). The average scores of attitudinal and beliefs scores for male Indonesian students is higher than the average for all other gender, except in students' belief about mathematics teaching (for female New Zealand students). The result of pairwise comparison in value (perceive usefulness) of mathematics, and beliefs about mathematics indicate no significant differences between male and female Indonesian students and between male and female New Zealand students. With beliefs about mathematics learning significant differences were found in most subgroups gender, except differences between male and female Indonesian students. Pair wise comparison also indicated significant differences in belief about mathematics teaching between female and male New Zealand students ($t = -3.066$, $p < 0.002$), between male New Zealand and female Indonesian students ($t = -2.009$, $p < 0.05$), and between female New Zealand and male Indonesian students ($t= -2.563$, $p < 0.011$).

5.5 The Open-ended Question Results

This section discusses student responses to open-ended items in the senior high school questionnaire (see Appendix A3 or A4, items 71-78). The open-ended questions provide a further probe to investigate differences or similarities between country and gender.

In general, the responses from the two population were quite similar. This is in agreement with the earlier analysis of Likert questions (Section 5.4) which showed similarities between the beliefs held by both Indonesian and New Zealand students. In some instances possible origins of student belief, or possible avenues for further research are included.

Q.71 How long do you spend on homework problems?

Most New Zealand students indicated that they spent less than 20 minutes. Indonesian students, however, spent longer: most of them spent between half-an-hour to two hours doing mathematics homework. Responses from both groups of students indicated the interaction of context and person factors: mood, situation, question type, and availability of time. There was a significant number of students from both countries who were unsure of their study patterns and several indicated that they do not do homework on a regular basis.

Q.72 What is the most important qualities of a good maths teachers?

The most common answer to this question was that a good mathematics teacher gives clear explanations, is patient, caring, helpful, kind, fair, and not grumpy. Specifically, New Zealand students listed the following attributes of a good mathematics teacher:

* gives good notes;

* committed to all students, not just the smart ones;
* has a good knowledge of their subject;
* gives you all the work necessary and makes sure you understand the work;
* sits down with you until you have got the problem solved;
* teaches what you want to learn;
* writes clearly on the board;
* lets students have an opinion;
* has the ability to make the subject understandable;
* does not to go too fast for the students' capabilities;
* helps you when you get stuck;
* is not boring to listen to;
* is open-minded to other opinions;
* can speak to a student one-on-one.

Similarly Indonesian students provided a wide range of qualities of a good mathematics teacher:
* no more note-taking;
* is honest;
* does not get angry too fast;
* has good sense of humour;
* does not pursue a target curriculum;
* is not stingy on marks;
* gives a variety problems;
* does not give a problem in exam that is more difficult than in class;
* easy to understand and does not use needlessly long sentences;
* is not in hurry to move to another topic;
* gives us a spirit;
* creates a serious but relax atmosphere.

Both groups of students include affective issues of interest, enjoyment and motivation in their responses and have some strong beliefs about effective teaching practices.

Q.73 What can you do if you get stuck while doing a maths problem? In class? At home?

Responses from both countries suggest various strategies for coping when they get stuck while doing maths problem. They range from 'keep on working' to 'panic'. The most common strategies included, leaving the question to come back to later, or seeking help from notes, friends, or teachers. At home, strategies included asking parents (mother, or father, or both), older siblings, ringing a friend, looking back to the text-book, or leaving it until class next day. Indonesian students frequently reported reliance on private mathematics teacher.

Q.74 How important is memorizing in learning maths? If anything else is important, please explain what.

Most of the New Zealand students endorsed the importance of memorizing. Three-quarters of them rated memorizing as very or extremely important. Typical responses included:

* it is important to memorize things like formulae, but it is also good to know and understand things, like just remembering how to do them;

* it is important as you have to follow certain ways; most of the time you cannot make up your own ways of answering questions.

However, the remaining students felt understanding was very important, either in conjunction with memorizing, or in preference to memorizing. For example:

* memorizing is not helpful; you need to understand it all so that you may adapt your knowledge to suit different situations;

* memorizing is not very important, because it does not require logic and problem-solving skills.

While most of the Indonesian students agreed that memorization was important their responses clearly endorsed the importance of task completion.

* the most important things is to keep trying to solve the problems;

* important, because if I do not memorize the formula, how can I do maths problem;
* if we often do exercises we have automatically memorized it, but if we only memorize, it means we do not learning maths properly;
* learning from practice is more important than just memorizing it;
* memorizing is not important. The most important thing is always actively do exercises;
* memorizing is not important. The most important thing is to understand logic of how it is done.

While there was strong agreement that memorizing formulae is important in that it can save the time, understanding is also important for these students.

Q.75 Is it particularly important to you to be good at mathematics (more important than other subjects)? Why / why not?

In both countries most students agreed with this question. Typical reasons for agreement by New Zealand students include both future career and advanced study:
* yes, so that I can understand money ways and it will be useful for my career;
* yes, can get a job;
* yes, without it everyday life would be difficult and it is needed for many jobs in the future;
* yes, mathematics is an integral part of physics, my best subject;
* yes, most subjects tie into maths;
* quite important because I would like to do a career in maths/science;
* yes, because I would like to do work in economics;
* yes, because I will need maths in the future more than I will need science and journalism;
* yes, because I just want to be good at it. It is always interested me as a subject as it makes you think a lot - but

not as something to continue as a career.

Likewise, disagreement reasons for New Zealand students included a mixture of intrinsic and extrinsic factors:
* no, because it is a waste time sitting around trying to be good at something that you just cannot do;
* no, it is not necessary to have a high level of maths for my career;
* not important, because you are not going to use all the things you do in maths later on;
* not important, because I am not good in maths;
* no, because not all jobs use maths;
* it is not important for me to be good at maths as I do not like it, therefore, I will aim for a career that does not involve complex maths so I do not mind if I am not good at it;
* no, I am more interested in English and history which do not involve particularly intricate calculations.
Overall, for New Zealand students, the strongest reasons for learning mathematics and wanting to do well in the course, were related to future career aspirations.

Typical agreement responses for Indonesian students included:
* to make me more self-confident;
* to make me more enthusiastic to learning;
* yes, because mathematics learning is not boring like other subjects;
* important, because it makes me proud if I get good mark;
* to enter tertiary education;
* yes, because maths is a base for all sciences;
* important, because it develops my thinking skills which one day can be used again;
* because maths is most important of all other subjects;
* because I am interested in it;
* because it would be useful for everyday life;
* to help to do other subjects;
* because my parents will be happy to see my good marks;

* because I want to make my parents to be proud of that;
* because I feel to get self-satisfaction and to pace myself to learn more.

Just one respondent disagreed with the question:
* no, it is not important because I have no talent in it.

For Indonesian students responses were more likely to include performance orientation and the desire to please parents. Also, perhaps because Indonesia is a developing industrialised societies the need for mathematics qualifications to gain high status jobs is not so evident as in New Zealand society.

Q.76 Has anyone in your school life to date encouraged you to continue in mathematics, (and if yes who and when), or has anyone discouraged you?

Students from both countries, choose on ranking: no one, their parents, and their mathematics teacher. Only a few admitted himself/herself as a self-motivator. However, it was notable that Indonesian students responses offered more variety; many considered that their older brother or sister, their friend, and their private teacher has encouraged them.

Q. 77 Is it your opinion that mathematics is for people with a special aptitude, or can every person with average intelligence master a substantial part of the subject?

The most common answer to this question from both countries is that everyone can do maths, given the right attitude or opportunities. Responses from New Zealand students included:
* everyone can do maths as long as they have had a good mathematics teacher and work hard;
* yes, the substantial part, but need to improve their attitude to go further;
* yes, but I would be inclined to think that it is better suited to people with a special aptitude;
* yes, with hard work and perseverance.

Similar reasons were suggested by Indonesian students, however, these was a particularly strong emphasis on student effort.
* everyone can do it if they do more maths exercises;
* everyone can do it, only the ability to understand it is different, some fast and some slow;
* depends on effort and their will;
* the human brain and thinking is similar, no one more than the other;
* someone who has average ability can do maths if they are diligent to do exercise and understand it.

Q.78 Discuss the often quoted theory that women are less talented in mathematics than men. Do you think this is true and why?

Almost all students disagree with the statement that "women are less talented in mathematics than men". New Zealand students justified their opinion as follows:
* depends on the previous teacher;
* depends on the person, not their sex;
* I think this theory is a prehistoric concept. I feel women are equal to men in maths and other subjects;
* I think men and women are equally talented in maths because we are all human and generally have the same brain capacity.

For Indonesian students, there are some agreement, but also some disagreement. Typical reasons for disagreement were similar to their New Zealand counterparts:
* it is not right, because the ability of someone is not dependent on gender;
* no, it depends on person itself;
* no, because the ability of the brain is not based on the gender or physical attributes of someone;
* depends on the level of diligence;
* no, because the abilities do not depend on gender but depend on ability itself.

Several Indonesian students, in fact, were supportive of females outperforming males. There arguments were consistent with responses in questionnaire and with views of Indonesian teachers (Section 5.2.1).

* absolutely wrong because it usual, women are more talented than men;
* do not forget women are more often getting good maths grades;
* definitely not right, because women are more diligent than men;
* no, because women are usually more accurate and careful, men are more logical but they are more lazy than women;
* women are more perseverance and patient.

Unlike New Zealand students, many Indonesian students did support the superiority of male mathematics performance.

* perhaps, because women often use their feeling rather than their logical thinking;
* it is right, because thinking patterns are different between men and women;
* yes, because men have a brain which is more stronger than women;
* yes, because the stamina to think of men is longer than that for women;
* yes, because women have less points of view, are less rational thinking when compared with men;
* it is right, because men use the right brain (ratio brain) to do the problem;
* yes, because women give up faster than men.

The agreements by Indonesian students reflect opinion about both the cognitive domain and affective domain. Such statements of strong agreement with Indonesian students is perhaps reflective of cultural differences, teaching practices and parental expectations.

In summary, there were both differences and similarities in Indonesia and New Zealand responses. Indonesian students are prepared to spend more time than New Zealand students in individual study. It appears that they have to work hard to achieve their goals and parental expectations. Indonesian students were frequently encouraged by their private mathematics teacher, using him or her to help with mathematics problems when they get stuck. This was not the case for New Zealand students.

When discussing learning, both groups of students believe that memorization is important, but understanding is more important. They also believe that everyone can do mathematics. Differences were noted in the emphasis: Indonesian students emphasised effort, compared with New Zealand students' emphasis on opportunities. With regard to mathematics teaching each group of students had strong beliefs which reflected their socio-cultural context.

For New Zealand students, the importance placed on achievement related to their career and advanced study; this was not so apparent for Indonesian students.

Concerning gender-related differences, almost all New Zealand students disagreed that "women are less talented in mathematics than men". However, for Indonesian students, responses varied from no difference, superiority of male and vice versa.

CHAPTER 6

CONCLUSIONS

6.1 DISCUSSION AND CONCLUSION

The breadth of this study makes it possible to gain insights into cross-national differences and gender differences within and among countries in attitudinal and beliefs scores. The results indicate that cross-national comparison of mathematics attitudes and beliefs may be more subtle and complex than has been suggested by many previous reports. Findings provide preliminary support for the claim that New Zealand and Indonesian students have different attitudes and beliefs about mathematics education.

6.1.1 Comparisons between New Zealand and Indonesian Students

As in the existing cross-national research, New Zealand and Indonesian students held significantly different attitudes concerning enjoyment of mathematics, value (perceive usefulness) of mathematics, beliefs about mathematics, beliefs about mathematics learning, and beliefs about home support. No differences were found, however, in term beliefs about themselves as mathematics learners, attribution to success and failure in mathematics learning, and their beliefs about mathematics teaching.

In their enjoyment of mathematics, Indonesian students perceive that mathematics is enjoyable and stimulating to them. Indonesian students believe that mathematics helps them to think clearly and logically. Indonesian students agreed significantly more that mathematics is required to study other subjects, mathematics will become even more important to everyday life in the future, and in the near future most jobs will require a knowledge of advanced mathematics. For

New Zealand students, they perceive that if they know mathematics it will help them get a job. This belief is consistent with the role of mathematics as a critical filter, controlling access to many areas of advanced study and professional occupations in New Zealand.

With regard to overall beliefs about themselves as learners, there were no significant differences between both countries. However, Indonesian students did place more value on hard work and overall performance. Additionally, they feel that they can learn better and remember something for longer if they have to discover it for themselves. While overall attribution scores showed no significant differences, Indonesian students were more likely attribute their success in mathematics learning to their own effort rather than their own ability.

When considering attitudes to class learning Indonesian students were more likely to be disappointed when they missed a maths lesson. Indonesian students also slightly disagreed, significantly so when compared with New Zealand counterparts, in their beliefs that mathematics lessons are boring, learning mathematics is more difficult than another subjects, and that they feel nervous when they are asked question in the class.

New Zealand students believe that learning mathematics is helped by lots of discussion questions during the lesson. This belief reflects the philosophy of *Mathematics in the New Zealand Curriculum* (Ministry of Education, 1992). When considering beliefs about mathematics and mathematics learning Schoenfeld (1992) argues that ordinary students do not expect to understand mathematics; they expect simply to memorize it and apply what they have learned mechanically and without understanding. In this present research students from either Indonesian or New Zealand did not concur with this beliefs. In contrast, most student believed that everyone can do maths, and many students believed that understanding is more important than memorization.

In their beliefs about home support, Indonesian students expressed stronger parental expectations for them to do well in maths. They have someone in their family who is able to help them with maths homework and reported, spending more time out of school on mathematics. It is also common for Indonesian students to have a private maths teacher.

Overall, belief scores about mathematics teaching between New Zealand and Indonesian students showed no significant differences. However, New Zealand students' perceptions of a good mathematics teacher profile different characteristics than those of Indonesian students. A good New Zealand maths teacher gives lots of notes and summaries, has genuine concern for student progress, provides feedback that is helpful, communicates knowledgeably on the subject, is well organised and comes to class prepared, shows you the exact way to answer the maths question you will be tested on, is enthusiastic, and thinks mistakes are OK as long as the students learn from them. On the other hand, a good Indonesian mathematics teacher makes it clear what students need to do to be successful in maths lesson, gives fair grades, and has a sense of humour.

6.1.2 Gender Comparisons within New Zealand Students and Indonesian Students

Gender differences within New Zealand students were only noted with regard to students' beliefs about mathematics learning and beliefs about mathematics teaching. Specifically, male students disagreed significantly more strongly than female students that in maths the answers are either right or wrong. Female students supported teaching practices in which the teacher allows students to put forward their own questions and problems in a lesson, gives fair grades, treats all students fairly, is patient and considerate, and thinks mistakes are okay as long as the students learn from them.

It is noteworthy that no significant gender differences were found within Indonesian students for overall attitudinal and beliefs scales. This contrasts with Jones and Young's (1995) study which found that gender differences in attitudes increase as the students progressed through school. This result also slightly contrasts with the open-ended question responses which showed a wide of range of opinions related to gender differences in achievement and ability.

However, when the results for **itemized** responses were analyzed significant differences for both attitudinal and beliefs scores were found. In Indonesia, female students agreed significantly more strongly than male students in the belief that it is important to have a private maths tutor and consider a good maths teacher to be one who shows control in class yet maintains a friendly relaxed atmosphere (see Table 5.7 and 5.10).

6.1.3 Comparisons among Subgroups Gender of Students

Differences among subgroups gender (males and females for New Zealand and Indonesia) were found in students' value (perceive usefulness) of mathematics, beliefs about mathematics, beliefs about mathematics learning, and beliefs about mathematics teaching. Significant differences were found in beliefs about mathematics teaching between female and male New Zealand students, female New Zealand and male Indonesia, and male New Zealand and female Indonesia. No significant differences were found in any of the categories for male and female Indonesian students.

6.1.4 Comparisons between New Zealand and Indonesian Teachers

Differences between New Zealand and Indonesian teachers beliefs about learning mathematics were found. Indonesian mathematics teachers emphasized students listening to the teacher explaining, note-taking to revise from, reading text-books, doing written exercises from text-books, watching a teacher work through a problem, working out practical problems, and opportunities for students to practice exam/test questions. Teaching methods stress rote learning, relying on drill of basic skills. In contrast New Zealand mathematics teachers emphasized teacher led discussion, teacher demonstrations, and teacher explanations, and student discussion.

New Zealand mathematics teachers valued the development of an attitude of enquiry, whereas Indonesian teachers emphasized the development of an awareness of the importance of mathematics in everyday life. Indonesian teachers more often used text-books, self-prepared tests, and self-prepared teaching materials than did New Zealand teachers. On the other hand, New Zealand teachers more often made use of published workbooks or problem sets, individualised materials, and commercially produced visual materials than did Indonesian teachers.

Comparison on current mathematics teaching practice between New Zealand and Indonesian teacher suggests that New Zealand teachers support a more constructivist approach to classroom learning and thus were more likely to emphasize the active involvement of the learner. Such perspectives in mathematics teaching in New Zealand have been strongly influenced by curriculum reforms which emphasis the importance of engaging students more actively in the process of constructing mathematical knowledge (Ministry of Education, 1992). However, there appear to the some conflicts in New Zealand classrooms: in agreement with Anthony (in press) study of year 12 students many pupils expressed a strong desire for teacher centred instruction, less reluctance to seek help, and reliance on weak, ineffective, cognitive, meta-learning strategies.

In Indonesia the typical form of mathematics instruction is based on a transmission model in which the teacher attempts to transmit mathematical facts and computational procedures to the students. Typically the students are passive participants in a more teachers directed classroom environment.

The differences between Indonesian and New Zealand education, identified on the basis of differences in mathematics teaching and differences in mathematics learning, are summarised in Table 6.1.

TABLE 6.1: Differences between Indonesian and New Zealand in Mathematics Education

Indonesian	New Zealand
Lesson structure is always teacher centered. Main mode of teaching is teacher explanations which is paced and clear.	Variety of lesson structure including tutorials, practicals, computers activities, libraries, investigations, etc.
Argumentation is not encouraged.	Teachers expect student-teacher discussion.
Considerable amount of information is presented.	Summaries of the state-of-the- art are presented.
Rote learning is common.	Evaluative learning is preferred.
Noncritical reception of information is expected.	Critical thought is encouraged.
Students work hard to learn every thing.	Students selectively learn the central concept as well as detail.
Few student initiatives are taken.	Independent learning and research are rewarded.

The comparison in education system, reflecting the socio-cultural context, may go some way to account for differences and similarities between New Zealand and Indonesian students' perception of their mathematics education.

6.2 Summary: Major Outcomes

* All students believed that mathematics serves as a critical filter, controlling access to many areas of advanced study and professional occupations. For New Zealand students this belief appear to be influenced by job orientation and future career aspirations; for Indonesian students, however, their beliefs about importance of mathematics appear to be linked with performance orientation and the desire to please their parents.

* This study suggests that effort, including work hard, diligence, and perseverance are identified as the primary determinant of Indonesian students' performance; effort receives relatively less emphasis by New Zealand students.

* It is common for Indonesian students to have a private mathematics teacher. Also the encouragement given to them by the teachers, private teachers, parents, and families appear to play a significant part in fostering positive attitudes towards the learning of mathematics and the development of self-confidence in their mathematics skills.

* In spite of evident cross-national differences in curriculum aims, teacher's belief about mathematics learning and teaching practices there did not appear to be any significant overall differences in students' belief about mathematics teaching.

* Several beliefs about learners and learning supported the notion that understanding is important. However, students revealed a sequential, hierarchical view of their learning process. Students must learn the basics before they are equipped to understand, with the basics being computational

algorithms and basic-fact combinations. A view of learning expressed by the teachers is that learning takes time and needs hard work and perseverance.

* Teachers' beliefs about learning usually go hand-in-hand with related beliefs about what is being learned and what it means to learn mathematics. The mathematics instruction that students experience, whether in a transmission mode, or in the more conceptually oriented approach envisioned in the *Mathematics in the New Zealand Curriculum* (1992) unfolds as teacher play the leading role in shaping the learning environment. All good teaching requires thoughtfulness, but the kind of mathematics teaching envisioned in the *Mathematics in the New Zealand Curriculum* relies heavily on teachers' judgements, knowledge, and beliefs.

* Indonesian mathematics teachers believe that students learn best when highly engaged and interested and thus aim to make mathematics learning enjoyable and relevant for students. They want their students to appreciate the relevance and usefulness of mathematics in their world. Any good mathematics teacher would be quick to point out that students' success or failure in learning mathematics often is much a matter non cognitive traits such as self-confidence, motivation, and perseverance, as it is the mathematical knowledge they possess.

6.3 FURTHER RESEARCH

This study indicates that there are cross-national differences in some aspects of attitudinal and beliefs variables. However, to understand clearly what attitudinal and belief constructs mediate cross-national differences in mathematics education, and how these construct manifest their effect, it may be necessary to further understand the specific nature of attitudinal and beliefs within the different cultures.

* In light of on-going curriculum reforms it would be interesting to monitor changing beliefs in a longitudinal study. One would hope that those attitudes and beliefs which are regarded as unproductive and negative outcomes of students' mathematical experiences will lessen with curriculum reforms.

* New and more refined instruments need to be developed to assess attitudes and beliefs. Written participant responses should be coupled with structured and clinical interviews with students and teachers from both countries.

* Also in view of the restriction in the geographical area covered in this study further research is needed to obtain data from a wide range of schools within the respective countries.

Appendix A1:

INFORMATION SHEET

Dear Parents/Guardian and Students,

My name is Gaguk Margono, and I am a Graduate Student of Mathematics Department, Massey University. As part of my research in Mathematics Education I am investigating the attitudes and beliefs about mathematics of senior mathematics students.

As a result of the experiences in mathematics classrooms students may develop a wide range of beliefs about mathematics, their mathematical ability, and learning and teaching of mathematics. Completing this questionnaire will help determine whether current beliefs are appropriate and helpful for students learning.

To gather data concerning students' attitudes to mathematics learning and teaching, I wish to administer a questionnaire to approximately 60 senior students. The school principal and class teacher has agreed that senior students can participate in this research study. This will involve mathematics students completing a voluntary questionnaire, of approximately 30 minutes duration, during a mathematics lesson. The resulting data will be compared with data from senior students in Indonesia.

If you take part in the study, you have the right to: (a) refuse to answer any particular question, and to withdraw from the study at any time, (b) ask any further questions about the study that occur to you during your participation, and (c) provide information on the understanding that it is completely confidential to the researcher. All information is collected anonymously, and it will not be possible to identify you in any reports that are prepared from the study.

If you have any questions about this research you may contact me at Massey on Ph: 356-9099 Ext. 7363, or you may write to me at: Gaguk Margono c/o Department of Education, Massey University Palmerston North or to my e-mail address G.Margono@massey.ac.nz.

Yours sincerely,

Gaguk Margono
Graduate Student

Appendix A2:

STUDENTS CONSENT FORM

I have read the Information Sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study at any time, or decline to answer any particular questions in the study. I agree to provide information to the researchers on the understanding that it is completely confidential.

I wish to participate in this study under the conditions set out on the Information Sheet.

Signed: ______________________________

Name: ______________________________

Date: ______________________________

Appendix A3:

Questionnaire

We are interested in your ideas about mathematics and mathematics learning. Please read each of the statement in the questionnaire carefully. In the table at the right of each statement tick the column which represents **how you feel** and **you own experiences**, in relation to the statement. There are **NO right or wrong answer**-just answer as honestly as you can.

This questionnaire is not part of your regular school work, and will not be graded by your teacher. Your answers to the questions that follow will help us to understand what you think about mathematics and your learning experiences. Your individual responses will remain anonymous so please tell us what your really think and **what you really think** and **what you really experience**.

Instruction: Circle the correct response.

1. I am in Form (a) 5
   (b) 6
   (c) 7

2. I am a (a) male
   (b) female

3. (a) I plan to finish studying maths this year
   (b) I plan to continue with more maths in the future
   (c) I am not sure whether I will study any more maths

Instruction: **Tick the appropriate column depending on if you;**

Strongly agree (SA)
Agree (A)
Neutral (N)
Disagree (D)
Strongly disagree (SD)

No.	Items #1	SA	A	N	D	SD
1.	Mathematics is enjoyable and stimulating to me.					
2.	I have never liked mathematics.					
3.	Doing well in maths is more important to me than enjoying the subject.					
4.	Mathematics makes me feel uneasy and confused.					
5.	Mathematics is required to study other subjects.					
6.	Mathematics is not important in everyday life.					
7.	If I know mathematics, it will help me to get a job.					
8.	A lot of the maths I learn in school I will never use later on.					
9.	Mathematics will become even more important to everyday life in the future.					
10.	Mathematics is of great importance to a country's development.					
11.	In the near future most jobs will require a knowledge of advanced mathematics.					
12.	Outside of science and engineering, there is little need for mathematics in most jobs.					
13.	Mathematics is too abstract and very complicated.					

Questionnaire (continued)

No.	Items #2	SA	A	N	D	SD
14.	Mathematics helps me to think clearly and logically.					
15.	Unlike most other subjects, in maths the answers are either right or wrong.					
16.	I am very good at mathematics.					
17.	I have no talent for mathematics.					
18.	My maths marks would be better if I worked harder.					
19.	Luck often determines the marks in my mathematics test.					
20.	Being good at mathematics is important for me.					
21.	I always feel nervous when I look at a maths problem.					
22.	To get good marks I have to work hard in mathematics.					
23.	No matter how much I try I have problems learning mathematics.					
24.	I prefer to discover things for myself in mathematics rather than be told.					
25.	I can learn better and remember something for longer if I have to discover it for myself.					
26.	I am as talented in maths as other students in my class.					
27.	If I work carefully I can usually do most of my maths problems.					
28.	If I do well in maths, it is usually because I am naturally very good at maths.					

Questionnaire (continued)

No.	Items #2	SA	A	N	D	SD
29.	If I do well in maths, it is usually because I have a good teacher.					
30.	If I do badly in maths it is usually because I am hopeless at it.					
31.	If I do badly in maths it is usually because I did not try hard enough.					
32.	If I do badly in maths it is usually because I was unlucky.					
33.	I am disappointed when I miss a maths lesson.					
34.	Mathematics lessons are boring.					
35.	I prefer to work on my own rather than in groups.					
36.	Mathematics is more than just calculating answers.					
37.	Homework problems are good for practice of work in class.					
38.	Learning mathematics is more difficult than another subjects.					
39.	Learning mathematics is helped by lots of discussion and questions during the lesson.					
40.	Learning mathematics involves mostly facts and procedures that have to imitated.					
41.	I can learn about maths in school, but rarely use it outside of school.					
42.	I am lucky when I do well on maths test.					
43.	I feel nervous when I am asked a question in the class.					
44.	My parents expect me to do well at maths.					

Questionnaire (continued)

No.	Items #2	SA	A	N	D	SD
45.	Someone in my family is able to help me with maths homework.					
46.	Someone in my family encourages me to learn maths.					
47.	I have a private maths tutor.					
No. 48.	**Item #3** **A good maths teacher:** Gives lots of examples which deal with practical situations.	**SA**	**A**	**N**	**D**	**SD**
49.	Is one who encourages me to learn more about mathematics.					
50.	Allows students to put forward their own questions and problems in a lesson.					
51.	Makes it clear what I need to do to be successful in a maths lesson.					
52.	Gives a lot of notes and summaries.					
53.	Has genuine concern for student progress.					
54.	Provides feedback that is helpful.					
55.	Communicates knowledgeably in this subject.					
56.	Is well organised and comes to class prepared.					
57.	Uses materials, language and examples which include all students (i.e. non-racist, non-sexist, etc.).					
58.	Gives fair grades.					
59.	Shows students lots of different ways to look at the same question.					
60.	Shows you the exact way to answer the maths question you will be tested on.					
61.	Treats all students fairly.					

Questionnaire (continued)

No.	Item #3 A good maths teacher:	SA	A	N	D	SD
62.	Shows control in class yet maintains friendly relaxed atmosphere.					
63.	Uses everyday life situations.					
64.	Is enthusiastic.					
65.	Has a sense of humour.					
66.	Is patient and considerate.					
67.	Often moves onto a new topic before I really understand the old one.					
68.	Wants all students to understand why things happen the way they do.					
69.	Thinks mistakes are OK, as long as students learn from them.					
70.	Covers all the material in this course, even if the students do not understand it all.					

Instruction: **Answer each of the following questions in a sentence or two. Write your answer in the space below each question.**

71. How long do you spend on homework problems?
72. What are the most important qualities of a good maths teachers?
73. What can you do if you get stuck while doing a maths problem? In class? At home?
74. How important is memorizing in learning maths? If anything else is important, please explain what.
75. Is it particularly important to you to be good at mathematics (more important than other subjects)? **Why/ why not?**
76. Has anyone in your school life encouraged you to continue in mathematics, (and if yes who and when), or has anyone discouraged you?
77. In your opinion, is mathematics for people with a special aptitude, or can every person with average intelligence master a substantial part of the subject?
78. Discuss the often quoted theory that women are less talented in mathematics than men. Do you think this is true and why?

THANK YOU VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Appendix A4:

KUESTIONER

Kami sangat tertarik dengan ide Anda tentang matematika. Di bawah ini ada beberapa pernyataan. Baca setiap pernyataan. Beri tanda (V) pada tabel di sebelah kanan setiap pernyataan yang **sesuai dengan perasaan dan pengalaman Anda sendiri** dalam setiap pernyataan. Tidak ada jawaban yang benar atau salah. Jawablah sejujur-jujurnya.

Kuestioner ini bukan bagian dari pekerjaan sekolah dan Anda tidak akan mempengaruhi nilai Anda. Jawaban Anda di bawah akan sangat menolong kami untuk memahami apa yang Anda pikirkan tentang matematika. Jawaban Anda selengkapnya adalah anonim. Tolong ceritakan kepada kami **apa yang sesungguhnya Anda pikirkan** dan **apa pengalaman Anda yang sesungguhnya.**

Terimakasih atas bantuan Anda.

Seksi # 0

Instruksi: Lingkari jawaban yang sesuai dengan keadaan Anda

1. Nama saya: (Tulis)

2. Saya sekarang duduk di kelas II... 1. A_1
   2. A_2
   3. A_3

3. Saya berjenis kelamin... 1. Perempuan
   2. Laki-laki

Waktu yang digunakan untuk melengkapi kuestioner ini sekitar 30 menit

Instruksi: Beri tanda (V) yang sesuai dengan pengalaman Anda;

Sangat setuju (SS)
Setuju (S)
Netral (N)
Tidak setuju (TS)
Sangat Tidak setuju (STS)

No.	Item #1	SS	S	N	TS	STS
1.	Matematika dapat dinikmati dan merangsang saya.					
2.	Saya tidak pernah menyukai matematika.					
3.	Bekerja dengan baik dalam matematika lebih penting daripada menikmatinya.					
4.	Matematika membuat saya merasa tidak enak dan membingungkan.					
5.	Matematika dibutuhkan dalam belajar subjek lainnya.					
6.	Matematika tidak penting dalam kehidupan sehari-hari.					
7.	Kalau saya mengetahui matematika, itu akan membantu saya mendapat pekerjaan.					
8.	Matematika yang kita pelajari di sekolah tidak akan pernah digunakan lagi nantinya.					
9.	Dimasa yang akan datang matematika akan menjadi lebih penting dalam kehidupan sehari-hari.					
10.	Matematika adalah sangat penting dalam pembangunan negara					
11.	Dalam waktu dekat ini akan banyak sekali pekerjaan yang memerlukan pengetahuan matematika lanjutan.					
12.	Diluar ilmu pengetahuan dan teknologi, hanya membutuhkan sedikit matematika dalam pekerjaan.					
13.	Matematika itu sangat abstrak dan rumit.					
14.	Matematika membantu saya berpikir jernih dan logis.					

Kuestioner (lanjutan)

No.	Item #2	SS	S	N	TS	STS
15.	Tidak seperti subjek lain dalam matematika hanya mengenal benar dan salah.					
16.	Saya sangat pandai dalam matematika.					
17.	Saya tidak berbakat dalam matematika.					
18.	Nilai matematika saya akan lebih baik bila saya kerja keras.					
19.	Nilai dalam tes matematika sering ditentukan oleh nasib.					
20.	Menjadi baik dalam nilai matematika adalah sangat penting bagi saya.					
21.	Saya selalu khawatir bila saya menghadapi soal matematika.					
22.	Saya harus bekerja keras untuk mendapat nilai yang baik dalam matematika.					
23.	Tidak menjadi soal seberapa banyak saya mencoba saya tetap mempunyai masalah dalam mempelajari matematika.					
24.	Saya lebih suka menemukan sesuatu untuk saya sendiri daripada diceritakan oleh orang lain.					
25.	Saya dapat mempelajari dengan baik dan mengingat lebih lama bila saya harus menemukannya sendiri.					
26.	Saya setingkat kemampuan saya dalam matematika bila dibandingkan dengan teman-teman sekelas saya.					
27.	Bila saya mengerjakannya berhati-hati, saya biasanya dapat mengerjakan banyak soal.					
28.	Bila saya baik dalam matematika itu karena umumnya saya sangat baik dalam hal ini.					
29.	Bila saya baik dalam matematika itu karena saya mempunyai guru yang baik.					

Kuestioner (lanjutan)

No.	I t e m # 2	SS	S	N	TS	STS
30.	Bila saya buruk dalam matematika karena saya sangat putus asa akan matematika.					
31.	Bila saya buruk dalam matematika karena saya tidak mencobanya dengan cukup sungguh-sungguh.					
32.	Bila saya buruk dalam matematika karena saya tidak beruntung.					
33.	Saya kecewa bila saya kehilangan pelajaran matematika.					
34.	Pelajaran matematika membosankan.					
35.	Dalam matematika saya lebih suka bekerja sendiri daripada dalam kelompok.					
36.	Matematika lebih daripada hanya menghitung.					
37.	Soal pekerjaan rumah baik untuk praktek di kelas.					
38.	Mempelajari matematika itu lebih sulit daripada mata pelajaran lain.					
39.	Mempelajari matematika banyak dibantu melalui diskusi dan pertanyaan selama pelajaran berlangsung.					
40.	Mempelajari matematika itu kebanyakan fakta dan prosedur yang harus ditirukan.					
41.	Saya dapat mempelajari matematika di sekolah, tetapi jarang dipakai di luar sekolah.					
42.	Saya hanya beruntung dapat mengerjakan dengan baik dalam tes matematika.					
43.	Saya merasa khawatir bila ditanya hal matematika di kelas.					
44.	Orangtua saya mengharapkan saya bagus dalam matematika.					

Kuestioner (lanjutan)

No.	Item #2	SS	S	N	TS	STS
45.	Seseorang dalam keluarga saya dapat membantu saya mengerjakan pekerjaan rumah.					
46.	Seseorang dalam keluarga saya mendorong saya mempelajari matematika.					
47.	Saya mempunyai guru privat matematika atau saya mengikuti bimbingan tes.					
	Item #3 **Guru matematika yang baik itu...**	SS	S	N	TS	STS
48.	Memberi banyak contoh yang berhubungan dengan kegunaan praktis.					
49.	Adalah sesorang yang mendorong saya untuk mempelajar lebih banyak lagi tentang matematika.					
50.	Mengijinkan murid mengajukan pertanyaan dan soal mereka selama pelajaran berlangsung.					
51.	Membuat jelas apa yang harus dikerjakan supaya sukses dalam pelajaran matematika.					
52.	Memberi banyak catatan dan kesimpulan.					
53.	Mempunyai keperdulian terhadap perkembangan murid.					
54.	Menyediakan umpan balik yanga sangat membantu.					
55.	Mengkomikasikan matematika secara keilmuan.					
56.	Adalah dapat mengorganisir dengan baik dan datang dengan persiapan mengajar.					
57.	Menggunakan materi, bahasa, dan contoh yang tidak menyinggung SARA (Suku, Agama, Ras, dan Antar golongan).					
58.	Memberi penilaian secara adil.					

Kuestioner (lanjutan)

No.	**Item #3** **Guru matematika yang baik itu...**	SS	S	N	TS	STS
59.	Memperlihatkan kepada murid banyak cara yang berbeda dalam menyelesaikan soal yang sama.					
60.	Menunjukkan kepada kamu dengan tepat jawaban soal matematika yang akan diteskan.					
61.	Memperlakukan semua murid dengan adil.					
62.	Mengontrol kelas dengan persahabatan dan suasana santai.					
63.	Menggunakan contoh dalam kehidupan sehari-hari.					
64.	Sangat bersemangat.					
65.	Mempunyai rasa humor.					
66.	Adalah sabar dan penuh perhatian.					
67.	Sering pindah ke topik baru sebelum saya sungguh-sungguh memahami yang lama.					
68.	Ingin agar semua murid memahami apa-apa yang mereka kerjakan.					
69.	Berpendapat kekeliruan adalah OK sepanjang murid-murid dapat belajar dari kesalahan mereka.					
70.	Mencakup semua materi pelajaran, walaupun murid-murid tidak memahaminya.					

Instruksi: **Jawablah setiap pertanyaan berikut ini dengan satu atau dua kalimat. Tulis jawaban Anda di ruang yang disediakan di setiap pertanyaan.**

71. Berapa lama Kamu mengerjakan soal Pekerjaan Rumah?

72. Apa sajakah sifat yang sangat penting dari guru matematika yang baik?

73. Apa yang Kamu lakukan kalau Kamu **mentok** dalam mengerjakan soal matematika? Di kelas? Di rumah?

74. Pentingkah menghafal dalam belajar matematika? Bila ada yang lain yang lebih penting, tolong jelaskan apa?

75. Apakah penting bagi Kamu terutama mendapat nilai baik dalam matematika (atau lebih penting mata pelajaran lain)? Mengapa/ mengapa tidak?

76. Adakah seseorang yang mendorong Kamu mempelajari matematika, (dan bila ya siapa dan kapan), atau tidak ada orang yang mendorong Kamu?

77. Menurut pendapatmu, apakah matematika hanya untuk mereka yang mempunyai kemampuan khusus, atau dapatkah setiap orang dengan kecerdasan rata-rata menguasai sebagian besar subjek ini?

78. Sering dalam diskusi, diteorikan bahwa wanita kurang berbakat dalam matematika daripada pria. Menurut pendapatmu, apakah itu betul dan mengapa begitu?

**TERIMA KASIH BANYAK ATAS KESEMPATAN,
UNTUK MELENGKAPI KUESTIONER INI**

Appendix A5 IEA questionnaires on objectives and resources

IEA QUESTIONNAIRE FOR TEACHERS

Teachers' Objectives the Teaching of Mathematics

Instruction: Below is a list of objectives related to teaching mathematics. Rate each objective as **MORE** than other objectives, **EQUAL** to other objectives, **LESS** than other objectives.

Teachers' Objectives the Teaching of Mathematics	More	Equal	Less
Develop an awareness of the importance of mathematics in everyday life.			
Understand the logical structure of mathematics			
Develop an awareness of important of mathematics in the basic and applied sciences			
Develop an attitude of enquiry			
Develop a systematic approach to solving problems			
Develop an interest in mathematics			
Know mathematical facts, principles and algorithms			
Understand the nature of proof			
Perform computation with speed and accuracy			

Resource Used by Teachers

Rate as used **OFTEN, SOMETIMES**, or **NEVER**

Resource Used by Teachers	Often	Sometimes	Never
Textbooks			
Self-prepared tests			
Self-prepared teaching materials			
Published workbooks or problem sets			
Individualised materials			
Commercially published tests			
Commercially produced visual materials			

Appendix A6 Questionnaires on practice and beliefs on learning

PART B

The following are statements about your current teaching practices.

For each question, please tick the option which best describes teaching mathematics with your class.

Teaching mathematics with my class currently involves:	**Never**	**Sometimes**	**Mostly**
1. Teacher led discussion			
2. Teacher demonstration			
3. Teacher explanations			
4. Media presentations			
5. Guest speakers			
6. Teacher-initiated investigations			
7. Students doing self-initiated investigations			
8. Exploring how ideas fit			
9. Students discussing in small group			
10.Students discussing as a class			
11.Students doing written task sheets			
12.Students writing mathematics in their own words			
13.Students consulting magazines and books for reference			
14.Mathematics projects, display work, or making posters			
15.Field trips and visits			
16.Students tackling new challenges			
17.Students exploring pitfalls and misconceptions			

Appendix A6 continue

The following are statements about what you believe helps mathematics learning. For each question, tick the option which best describes your beliefs about the activity describes in relation to mathematics learning.

In my experience, learning mathematics is helped by:	**Never**	**Sometimes**	**Mostly**
1. Students listening to the teacher explaining			
2. Students taking good notes to revise from			
3. Opportunities for students to practice exam/test questions			
4. Students reading text-books			
5. Students doing written exercises from text-books			
6. Students watching a teacher work through a problem			
7. Students working out practical problems			
8. Students talking and listening to other students in groups			
9. Students asking questions			
10.Students carrying out investigations			
11.Students tinkering around with equipment			
12.Students reading books (apart from text-books)			
13.Students talking and listening to experts			
14.Students browsing in the library			
15.Students testing out their own ideas			
16.Students solving puzzles and games			
17.Students reflecting on their own ideas			
18.Students evaluating what they have learnt			
19.Students examining misconceptions and confusions			
20.Students drawing and justifying conclusions			

Appendix A7 The type of interview questions

Attitudes toward mathematics

1. Tell me, how do you feel about mathematics?
2. Tell me, how do you feel about learning mathematics?
3. What are the things you do to help you learn mathematics?
4. How important is memorizing in learning maths? If anything else is important, please explain what.
5. Is it particularly important to you to be good at mathematics (more important than other subjects)? Why/ why not?

Students' perception about mathematics teaching

1. In your opinion, what are the key characteristics/qualities of a good mathematics teacher?
2. What are the key characteristics/qualities of those whom we think are not good mathematics teachers?
3. According to you, what are the key roles of a mathematics teacher in the classroom?
4. What should a mathematics teacher do in the classroom?
5. Do you agree, during the maths lesson you can put forward your own questions and problems? Why/ why not?
6. Have your teachers encouraged to you to solve problems as independently as possible?
7. Have your teachers taught you that everything in mathematics will always be reasoned exactly?
8. How can your teacher to improve your performance in mathematics tests?
9. In your point of view, does mathematics teaching in your classroom stimulate you to learn more mathematics?

Beliefs about the reason for success

1. Do you think that you have to work hard to do well in mathematics? Why/ Why not?
2. How much do you effort in doing mathematics? Why/ why not?
3. Do you believe achievement in mathematics depends on diligence? Why/ why not?
4. According to you, are you doing as well in school as your parents want you to?
5. If you failure to understand the math, what would you do?
6. Do ever you try to explain your ideas to other students?
7. How long do you spend on homework problems before you give up?
8. What would make you a better maths student?
9. What can you do if you get stuck while doing a maths problem?
10. Has anyone in your school life to date encouraged you to continue in mathematics, (and if yes who and when), or has anyone discouraged you?
11. Is it your opinion that mathematics is for people with a special ability, or can every person with average intelligence learn mathematics? Why?

Gender

1. What do you consider "men can do better than women in mathematics or women can do better than men in mathematics"? Why/ why not?
2. Do you personally believe that women can attain the same level of competence in mathematics as men, or do you consider men are better at learning mathematics?

Indonesian version: Tipe pertanyaan-pertanyaan dalam interview

Sikap terhadap matematika

1. Tolong ceritakan, bagaimanakah pendapatmu tentang matematika?
2. Tolong ceritakan, bagaimanakah pendapatmu tentang belajar matematika?
3. Apa saja menurut kamu yang membantu kamu belajar matematika?
4. Bagaimanakah pentingnya menghafal dalam matematika? Bila ada yang lain yang penting, tolong jelaskan.
5. Apakah lebih penting bagus dalam pelajaran matematika daripada dalam pelajaran lainnya? Kenapa/ kenapa tidak?

Persepsi siswa tentang pengajaran matematika

1. Menurut pendapat kamu, apa saja sifat/kualitas kunci dari guru matematika yang baik?
2. Apa saja sifat/kualitas kunci dari guru matematika yang tidak baik?
3. Menurut kamu, apa saja peranan kunci dari guru matematika di dalam kelas?
4. Apa saja yang sebaiknya dilaksanakan oleh guru di depan kelas?
5. Apakah kamu setuju, selama berlangsung pengajaran kamu megusulkan pertanyaanmu dan persoalanmu? Kenapa/ kenapa tidak?
6. Apakah gurumu telah mendorong kamu memecahkan persoalan secara mandiri sebisa mungkin?
7. Apakah gurumu mengajar kamu bahwa segala sesuatu dalam matematika selalu ada ada alasan yang masuk akal?
8. Bagaimana caranya gurumu memperbaiki kemampuanmu dalam tes matematika?
9. Dari titik pandanganmu, pengajaran matematika dikelasmu merangsang kamu untuk belajar matematika lebih banyak lagi?

Tingkat kepercayaan tentang alasan untuk sukses

1. Apakah kamu merasa bahwa kamu harus bekerja keras untuk dapat nilai yang bagus dalam matematika? Bila ya, kenapa? Bila tidak, kenapa tidak?
2. Seberapa jauh usahamu dalam belajar matematika? Bila ya, kenapa? Bila tidak, kenapa tidak?
3. Apakah kamu percaya bahwa prestasi dalam matematika itu tergantung pada kerajinan? Bila ya, kenapa? Bila tidak, kenapa tidak?
4. Munurut kamu, kamu belajar sebagus di sekolah sesuai dengan yang diinginkan oleh orangtuamu?
5. Bila kamu gagal memahami pelajaran matematika, apa yang akan kamu lakukan?
6. Apakah kamu selalu mencoba menerangkan gagasanmu kepada siswa lainnya?
7. Berapa lama kamu mengerjakan PR sebelum kamu menyerah?
8. Apa saja yang kamu kerjakan untuk berhasil dalam matematika?
9. Apa saja yang kamu kerjakan kalau kamu mentok dalam mengerjakan soal matematika?
10. Apakah ada seseorang yang mendorong kamu melanjutkan belajar matematika, (bila ya, siapa dan kapan), Apakah ada seseorang yang mematahkan semangatmu?
11. Menurut pendapatmu, bahwasanya matematika itu hanya untuk seseorang dengan kemampuan dasar khusus, atau setiap orang dengan kecerdasan rata-rata belajar atau mengerjakan matematika?

Gender

1. Manakah yang kamu pertimbangkan "laki-laki lebih baik daripada wanita dalam matematika atau wanita lebih baik daripada laki-laki dalam matematika"? Mengapa/ mengapa tidak?
2. Apakah secara pribadi kamu percaya bahwasanya wanita sama tingkatannya dengan laki-laki dalam kemampuan belajar matematika, atau laki-laki lebih baik dalam belajar matematika?

Appendix A8 ANOVA for attitudinal and beliefs scores by gender

ANOVA for enjoyment of mathematics

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	30.773	10.258	2.02	0.1119
Error	227	1152.664	5.078		
Total	230	1183.437		Note: non-significant	

ANOVA for value of mathematics

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	225.852	75.284	5.79	0.0008
Error	230	2992.494	13.011		
Total	233	3218.346		**Note: significant**	

ANOVA for beliefs about mathematics

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	55.042	18.347	6.00	0.0006
Error	234	715.277	3.057		
Total	237	770.319		**Note: significant**	

ANOVA for beliefs about self as learners

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	120.495	40.165	2.16	0.0938
Error	232	4319.301	18.618		
Total	235	4439.797		Note: non-significant	

Appendix A8 continues

ANOVA for attribution to success and failure in mathematics

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	21.491	7.164	1.25	0.2916
Error	232	1327.136	5.720		
Total	235	1348.627		Note: non-significant	

ANOVA for beliefs about mathematics learning

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	403.361	134.454	10.38	0.0001
Error	232	3003.736	12.947		
Total	235	3407.097		**Note: significant**	

ANOVA for beliefs about home support

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	47.943	15.981	2.21	0.0881
Error	233	1687.787	7.244		
Total	236	1735.729		Note: non-significant	

ANOVA for beliefs about mathematics teaching

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	776.611	258.870	3.71	0.0123
Error	229	15967.887	69.729		
Total	232	16744.498		**Note: significant**	

Appendix A9 Pairwise comparison of mean for attitudinal and beliefs scores by gender

Pair comparison of means in ANOVA (value of mathematics)

GENDER	MEAN	t & p value 1	2	3	4
1	28.0476190	.	-0.16684 0.8676	-3.12323 **0.0020***	-2.17753 **0.0305***
2	28.2500000	0.166837 0.8676	.	-3.07751 **0.0023***	-2.08018 **0.0386***
3	**31.1235955**	3.123229 **0.0020***	3.07751 **0.0023***	.	1.591475 0.1129
4	30.1752577	2.177534 **0.0305***	2.080176 **0.0386***	-1.59148 0.1129	.

Pair comparison of means in ANOVA (beliefs about maths)

GENDER	MEAN	t & p value 1	2	3	4
1	8.26086957	.	0.347999 0.7282	-3.01349 **0.0029***	-2.17582 **0.0306***
2	8.08333333	-0.348 0.7282	.	-3.50803 **0.0005***	-2.65987 **0.0084***
3	**9.48913043**	3.013493 **0.0029***	3.508034 **0.0005***	.	1.373379 0.1709
4	9.14141414	2.175823 **0.0306***	2.659868 **0.0084***	-1.37338 0.1709	.

Pair comparison of means in ANOVA (beliefs about maths learning)

GENDER	MEAN	t & p value 1	2	3	4
1	29.2173913	.	-2.17175 **0.0309***	-5.23721 **0.0001***	-4.6871 **0.0001***
2	31.5217391	2.171751 **0.0309***	.	-2.49315 **0.0134***	-1.9204 **0.0560***
3	**33.6153846**	5.237208 **0.0001***	2.49315 **0.0134***	.	0.9457 0.3453
4	33.1212121	4.687104 **0.0001***	1.9204 **0.0560***	-0.9457 0.3453	.

Appendix A9 continues

Pair comparison of means in ANOVA (beliefs about maths teaching)

GENDER	MEAN	t & p value 1	2	3	4
1	89.2608696	.	-3.06601 **0.0024***	-1.28583 0.1998	-2.00942 **0.0457***
2	**96.9166667**	3.066014 **0.0024***	.	2.562945 **0.0110***	1.883984 0.0609
3	91.8470588	1.285834 0.1998	-2.56294 **0.0110***	.	-1.10209 0.2716
4	93.2448980	2.009416 **0.0457***	-1.88398 0.0609	1.10209 0.2716	.

Note:

1 represents male New Zealand students

2 represents female New Zealand students

3 represents male Indonesian students

4 represents female Indonesian students

*** indicates significant differences**

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