FACTORS INFLUENCING THE ACHIEVEMENT IN MATHEMATICS OF MALAY SECONDARY SCHOOL STUDENT

CHE A. HALIM BIN CHE DAUD

MASTER OF SCIENCE
UNIVERSITY PUTRA MALAYSIA
2001

FACTORS INFLUENCING THE ACHIEVEMENT IN MATHEMATICS OF MALAY SECONDARY SCHOOL STUDENTS

By

CHE A. HALIM BIN CHE DAUD

Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Management and Economics Universiti Putra Malaysia

May 2001

DEDICATION

This work is dedicated to all mathematics teachers who have been working hard in helping their students succeed in learning mathematics.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

FACTORS INFLUENCING THE ACHIEVEMENT IN MATHEMATICS OF MALAY SECONDARY SCHOOL STUDENTS

By

CHE A. HALIM BIN CHE DAUD

MAY 2001

Chairman : Associate Professor Mohd Salleh bin Lebar, M. Sc

Faculty : Management and Economics (Department of Education)

The present situation of many secondary school students having difficulty in learning mathematics needs to be thoroughly investigated. Various factors need to be studied in order to determine why these students failed to perform satisfactorily in mathematics. For this research, a group of three hundred secondary school students were studied in order to determine the influence of students' internal characteristics on achievements in mathematics. This research focused on the following seven internal characteristics: Attitudes towards mathematics, mathematics anxiety, motivation to study mathematics, personality and behavioural characteristics, cognitive readiness, learning strategies, and learning styles.

For learning styles, Kolb's Learning Style Inventory (1985) was used. Cognitive readiness test consisted of questions involving abstract reasoning, logical thinking, and numerical computation. For the other variables, the tests consisted of questionnaires using likert scale from one to five. Mathematics achievements were determined by the scores that the students got for mathematics in the Trial SPM Examination, 1999.

The research findings showed that mathematics achievements were significantly and positively correlated with attitudes towards mathematics, motivation to study mathematics, and personality and behavioural characteristics. Mathematics anxiety, on the other hand, had negative influence on achievements in mathematics. The result suggested that efforts must be made to reduce the level of mathematics anxiety in order to raise the students' performance in mathematics.

Mathematics achievements were found to correlate strongly with abstract reasoning, logical thinking, and numerical computational abilities. As for learning strategies, higher achievers were found to be more oriented towards meaningful learning, as opposed to rote memorising. The findings for learning styles indicated that higher achievers were more oriented towards abstract conceptualisation and active experimentation modes of learning. Convergence was found to be the dominant learning style of students who were excellent in mathematics.

ACKNOWLEDGEMENTS

I would like to thank and express my deep gratitude to both of my former and present chairman of the supervisory committee, Associate Professor Dr. Mohd Khalid bin Mohd Nor and Associate Professor Salleh bin Lebar for their invaluable contribution, inputs and supervision of my Master programme in Kolej University Terengganu, University Putra Malaysia. Without their guidance and encouragement, the study would not have succeeded and this thesis would not have been written.

I would like to express my sincere heartfelt thanks to Associate Professor Dr. Mohd Khalid bin Mohd Nor for his willingness to supervise this study as a member of the supervisory committee after his transfer to University Putra Malaysia, Serdang in June 2000. I am very much indebted to him for his invaluable contribution and inputs in the study while he was the chairman of the supervisory committee from January 1999 to June 2000. I would like to extend my appreciation and gratitude to Associate Professor Salleh bin Lebar for his guidance and contribution as chairman of the supervisory committee from June 2000 until the completion of the writing of this thesis.

I also would like to express sincere heartfelt thanks and gratitude to the committee members of the supervisory committee, Associate Professor Dr. Shamsuddin bin Hussin and Mr. Mohd Nordin bin Mohd Abdullah for their invaluable contribution in the study. Associate Professor Dr. Shamsuddin bin Hussin was not able to supervise this study until the completion of this thesis because of his retirement

In the inter-groups comparison analyses, the findings showed that weak students did not have positive attitudes and strong motivation to succeed in learning mathematics. Their levels of mathematics anxiety were relatively high, and their personality and behavioural characteristics were relatively unfavourable. Weak students also had a relatively lower level of ability in abstract reasoning, logical thinking, and numerical computation. Weak students were more oriented towards rote memorising and concrete experiencing mode of learning.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

FAKTOR-FAKTOR YANG MEMPENGARUHI PENCAPAIAN DALAM MATEMATIK OLEH PELAJAR-PELAJAR MELAYU SEKOLAH MENENGAH

Oleh

CHE A. HALIM BIN CHE DAUD

MEI 2001

Pengerusi: Profesor Madya Mohd Salleh bin Lebar, M. Sc

Fakulti: Pengurusan dan Ekonomi (Jabatan Pendidikan)

Keadaan sekarang di mana ramai pelajar sekolah menengah mengalami kesukaran mempelajari matematik memerlukan penyiasatan yang rapi. Pelbagai faktor perlu dikaji untuk menentukan kenapa pelajar-pelajar ini gagal mencapai prestasi yang memuaskan dalam matematik. Untuk kajian ini, sekumpulan tiga ratus orang pelajar sekolah menengah telah dikaji untuk menentukan pengaruh ciri-ciri dalaman pelajar ke atas pencapaian dalam matematik. Kajian ini menumpukan kepada tujuh ciri-ciri dalaman berikut: Sikap terhadap matematik, kerisauan terhadap matematik, motivasi untuk belajar matematik, sahsiah dan ciri-ciri tingkah laku, kesediaan kognitif, strategi pembelajaran, dan gaya pembelajaran.

Bagi gaya pembelajaran, Inventori Gaya Pembelajaran Kolb (1985) telah digunakan. Ujian kesediaan kognitif mengandungi soalan-soalan mengenai keupayaan berhujah secara abstrak, berfikir secara logikal, dan kemahiran mengira. Bagi pembolehubah-pembolehubah yang lain, ujian-ujian mengandungi soalan-soalan yang menggunakan skala likert dari satu hingga lima. Pencapaian dalam matematik ditentukan oleh markah yang pelajar-pelajar perolehi bagi matematik dalam Peperiksaan Percubaan SPM 1999.

Hasil kajian menunjukkan bahawa pencapaian dalam matematik mempunyai korelasi yang signifikan dan positif dengan sikap terhadap matematik, motivasi untuk belajar matermatik, sahsiah dan ciri-ciri tingkah laku. Kerisauan terhadap matematik, di sebaliknya, mempunyai pengaruh yang negatif ke atas pencapaian dalam matematik. Hasil kajian mencadangkan usaha perlu dibuat bagi mengurangkan tahap kerisauan terhadap matematik agar pencapaian dalam matematik dapat ditingkatkan.

Pencapaian dalam matematik mempunyai korelasi yang kuat dengan kebolehan berhujah secara abstrak, berfikir secara logikal, dan mengira. Bagi strategi pembelajaran, pelajar-pelajar yang mempunyai pencapaian tinggi dalam matematik didapati lebih cenderung kepada pembelajaran yang bermakna, dan bukan pembelajaran secara hafalan. Hasil kajian bagi gaya pembelajaran menunjukkan bahawa pelajar-pelajar yang mempunyai pencapaian tinggi dalam matematik lebih cenderung kepada kaedah belajar yang menekankan konseptualisasi abstrak dan pengkajian aktif. Konvergen telah didapati sebagai gaya pembelajaran yang dominan di kalangan pelajar-pelajar yang cemerlang dalam matematik.

Dalam analisis perbandingan antara kumpulan, hasil kajian menunjukkan bahawa mereka tidak mempunyai sikap yang positif dan motivasi yang kuat untuk berjaya dalam pembelajaran matematik. Mereka mempunyai tahap kerisauan yang lebih tinggi terhadap matematik, dan sahsiah dan ciri-ciri tingkah laku yang kurang memuaskan. Pelajar-pelajar lemah mempunyai tahap keupayaan yang lebih rendah dalam penghujahan abstrak, pemikiran logikal, dan kemahiran mengira. Pelajar-pelajar lemah lebih cenderung kepada menghafal dan mengalami secara konkrit sebagai kaedah pembelajaran mereka.

from the university in May 2000. However, I am greatly indebted to him for giving me invaluable contribution and inputs from the beginning of my Master programme in Kolej University Terengganu, University Putra Malaysia.

I also would like to extend my deep appreciation and heartfelt thanks to Associate Professor Dr. Sakri bin Ibrahim and Mr. Abdul Rahim bin Ibrahim for giving me assistance, guidance and encouragement during my study at the university.

I wish to acknowledge and express my deep gratitude to my employer, Majlis Amanah Rakyat (MARA) for giving me study leave and financial assistance which has enabled me to carry out this research for Master programme.

Finally, I would like to express my deepest gratitude to my parents, my wife and my sons and daughters. Words are not enough to express my heartfelt feelings to my parents for providing me guidance, support and encouragement since childhood. Last but not least, a very special note of sincere thanks is due to my wife, Faudziah, for her patience to bear with me throughout the course of my study, and for the inspiration, enthusiasm and encouragement which she has always given me.

I certify that an Examination Committee met on 26th July 2001 to conduct the final examination of Che A Halim bin Che Daud on his Master of Science thesis entitled "Internal Characteristics of Malay Secondary School Students and Their Relationships with Mathematics Achievements" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

WAN SALIHIN WONG ABDULLAH, Ph.D.
Associate Professor
Faculty of Management and Economics
University College of Science and Technology Malaysia
(Chairman)

MOHD SALLEH BIN LEBAR, M.Sc.
Associate Professor
Faculty of Management and Economics
University College of Science and Technology Malaysia
(Member)

MOHD KHALID BIN MOHD NOR, Ph.D.
Associate Professor
Universiti Putra Malaysia
(Member)

MOHD NORDIN BIN MOHD ABDULLAH, M.Sc.
Faculty of Management and Economics
University College of Science and Technology Malaysia
(Member)

KHALID BIN SAMO, Ph.D.
Deputy Dean of Graduate School
University College of Science
and Technology Malaysia

Date: 24 SEP 2001

This thesis is submitted to the Senate of Universiti Putra Malaysia and was accepted as fulfillment of the requirements for the degree of Master of Science.

....

NORHAYATI BT. MOHD TAHIR, Ph.D.
Associate Professor
Dean of Graduate School
University College of Science
and Technology Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

....

CHE A. HALIM BIN CHE DAUD

Date: 24 SEP 2001

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of Research

Many students in secondary schools have shown great difficulty in learning mathematics. Results in standardised examinations such as the standard six Ujian Penilaian Sekolah Rendah (UPSR), form three Penilaian Menengah Rendah (PMR) and form five Sijil Pelajaran Malaysia (SPM), have shown that majority of these students failed to score good grades in mathematics. Parents, teachers and others involved in education have expressed their great concern to this situation. Mathematics teachers are very much aware of this situation, and they are under intense pressure to raise the achievement level of their students in mathematics. Efforts have been made to remedy the situation, but many mathematics teachers have found that this task is not easy. Most of their efforts have not produced significant improvement in the performance of students in mathematics.

Mathematics teachers are indeed facing a challenging task in raising the ability of these students to learn mathematics. As a mathematics teacher, who has been teaching mathematics for a number of years at Maktab Rendah Sains MARA (MRSM), which is a fully residential school, the researcher finds the situation very disturbing. Only good students who have performed well in form three PMR Examination, with at least 6As including mathematics and science. are selected to study in MRSM. Among these good selected students. there exists a large number of students who have difficulty in learning mathematics. especially additional mathematics. Even though they are highly motivated. and have given effort and shown interest towards the subject, a large number of them have shown great difficulty in learning mathematics, and subsequently. failed in tests given by their teachers.

In the end of the semester or end of the year examinations, it is normal to see the majority of these students failed in additional mathematics. Figures in table 1.1 give an example of how poorly the majority of these students performed in additional mathematics test. In non-residential schools. especially in the rural areas. we can expect to see a much more disappointing performance in additional mathematics.

Table 1.1 Results of Trial SPM Examination 1996

Maktab Rendah Sains MARA, Kuala Terengganu

Subject: Additional Mathematics

Source: Examination Unit

Maktab Rendah Sains MARA, Kuala Terengganu (1997)

Score	No. of students	Percentage
0 ------ 10	7	2.24
11 ------ 20	28	8.95
21 ------ 30	73	23.32
31 ------ 40	86	27.48
41 ------ 50	61	19.49
51 ------ 60	33	10.54
61 ------ 70	17	5.43
71 ------ 80	7	2.24
81 ------ 90	1	0.32
91 ------ 100	0	0

Total number of students : 313

Min score : 37.63 %

Standard deviation : 15.25

Maktab Rendah Sains MARA, Kuala Terengganu is a fully residential school. From Table 1.1, we can see that even among these selected students, the majority of them had not performed satisfactorily in additional mathematics. From the 313 students. 194 (62 %) scored less than 40 marks in the examination. Only one student was able to score more than 80 marks. The low min score of 37.63 % is a clear indication of how poorly this group of students performed in additional mathematics. With such an unsatisfactory performance in additional mathematics among selected students in a fully residential school, one should not be surprised to see much worse results among ordinary students in daily schools. Many of these students given up hope of succeeding in additional mathematics.

Situation like this is disheartening to mathematics teachers. Much time and effort have been given by both, the teachers and students involved, but not much success has been achieved. Many researchers in mathematics education have focussed their research on this problem. Richard R. Skemp (1986) expressed his concern with the problem of students who, though intelligent and hard-working, seemed to have a blockage about mathematics. This had led him to study and investigate the problems of learning mathematics. He suggested that there seemed to be a qualitative difference between two kinds of learning which he called habit learning or rote-memorising, and intelligent learning, which involves understanding. Because of the abstract nature of mathematical knowledge, which involves the formation of conceptual structures communicated and manipulated by means of symbols, the study of mathematics requires intelligent learning.

Gay and Cole (1967) studied mathematics learning difficulties of Kpelle pupils in Liberia. They concluded that there did not exist any inherent difficulties. What happened in the classroom was that the contents did not make any sense from the point of view of Kpelle culture; moreover the methods used were primarily on rote memory and harsh discipline. In another study in Australia (Christie, 1985), it was found that the present approaches to mathematics education resulted in the Aboriginal children perceiving school mathematics more in terms of meaningless ritual than as a purposeful pursuit. Much of this unstable mathematical knowledge was soon forgotten.

Mathematics is abstract by nature, and abstractions take one away form a context, and knowledge learned without context is literally meaningless. Of course, mathematical ideas offer their own kind of context, so it is very possible to develop meanings within mathematics (Bishop, 1988). Mathematics involved the study of abstract objects : Facts, concepts, operations and principles (Begle, 1979). Because of its abstractness, it can be comprehended only by a few and with great difficulty.

Romberg (1992) contended that there needs to be a shift from the notion that mathematics is a set of rules and formalisms invented by experts, which everyone else is to memorise and use to obtain unique correct answers, to a view that learning mathematics involves processes of abstraction, inference and logical reasoning. From this perspective, learning mathematics should emphasise constructing mathematical meaning.

Currently, many educational researchers view learners as " architects building their own knowledge structures " (Wang, Haertel and Walberg, 1993). The learner is not a passive recipient of knowledge but an active constructor of knowledge. Learning is a process of knowledge construction, but not of knowledge recording or absorption. Current knowledge is used to construct a new knowledge. Learning is not a passive receiving of ready-made knowledge but it is a process of construction in which the students themselves have to be the primary actors (von Glasersfeld, 1991). The learner does not passively receive and record information, but he/she actively interprets and constructs meaning through the existing knowledge structures that he/she has earlier acquired.

The difficulty in learning mathematics is very much due to the highly abstract and conceptual nature of mathematical knowledge. This is further aggravated by the many symbols and notations which are used to communicate the knowledge. Many students face the problem of understanding mathematical lessons that are presented in the classrooms. They either fail to construct meaning or the meaning that they constructed is not consistent with what the teacher explains.

Learning and teaching strategies that are being practised in school very often do not promote intelligent learning. Much emphasis is put on rote-memorising and algorithmic learning. Drilling is highly practised, where students are required to solve a lot of problems with the hope that they will be able to solve similar problems in tests or examinations. A lot of emphasis is put on learning of procedures, which is the " how" aspect of learning, but little attention is given to the "why" aspect.

Two learning approaches in the processing of information in learning situations have been identified : Deep and surface approaches (Entwistle, 1987; Marton, Hounsell, & Entwistle, 1984; Marton & Saljo, 1976). In deep processing approach, learners regard the learning material as a means by which to gain an understanding of the underlying meaning of the material. These learners are intrinsically motivated and they learn for the sake of learning, with less concern on their performance or evaluations of their performance by others. This approach will lead to far greater understanding of the material that is being studied.

In surface processing approach, learners regard the learning material as what needs to be learned, without attempting to link it to a larger conceptual framework. These learners are extrinsically motivated. They are motivated to fulfil the demands placed on them by others, and are particularly sensitive to assessment procedures. They regard learning as a passive transmission of the learning material to their brain, with particular emphasis on rote-memorising in acquiring knowledge. Usually, these students study just for the sake of examinations.

Psychological and cognitive factors also contribute to the difficulties in learning mathematics. Students' psychological and cognitive readiness influences the ability of these students to learn mathematics. Students who have negative attitudes towards learning mathematics, lack of self-discipline, and have a high level of anxiety will encounter difficulty in learning mathematics.

Positive attitude towards mathematics is a prerequisite if a student is to succeed in learning mathematics. It is this psychological barrier that inhibits many students from performing well in mathematics. Students who view mathematics as difficult, uninteresting, meaningless, boring and who hate or even fear mathematics, will, certainly, encounter not only learning difficulties, but they may also be in a situation of total mental blockage towards the subject. Mathematics achievements and attitude towards mathematics are highly correlated (Cheung, 1988).

According to Aiken (1986), attitude towards mathematics develops as soon as children are exposed to the subject, but the age 11 – 13 appear to be particularly important. At this time, negative attitude becomes especially noticeable. It is still not clear whether the increase in negative attitude at this stage of development is due to greater abstractions of mathematics material to be learned, to social or sex preoccupations, or to some other factors.

The structure of mathematics knowledge is hierarchical in nature. Mathematics lessons are usually taught sequentially. Topics are properly sequenced so that a topic, which is a prerequisite to another topic, is taught first. Within a particular topic, the subtopics are taught in a proper sequence. The understanding of a particular subtopic is dependent upon understanding the earlier subtopics. Due to this hierarchical structure, students who have self-disciplinary problems such as not attending class, unable to finish homework for a particular subtopic on time. will face difficulty in learning mathematics. Students have to be at the same level of learning sequence with their teacher at all times. Students who have problems in learning mathematics are the ones who are always left behind in their work. While the teacher has progressed to a new chapter, these problematic students are still struggling to finish the work and to try to understand the earlier chapter.

Anxiety is a common experience in mathematics learning situations. The difficulty in understanding the material being taught in class, and the fear of failure in tests will give rise to anxiety. The more anxious the students become. the harder they try, but the worse they are able to perform. This is because the reflective activity of intelligence is most easily inhibited by anxiety (Skemp. 1986). In learning situations which require students to think abstractly and reflect. it is important that anxiety is kept to the minimum level.

Cognitive readiness is an important factor in determining the ability of students to learn mathematics. To learn mathematics successfully at the secondary school level, the students' cognitive structures have to be at the stage where they are able to think abstractly and reason logically. According to Piaget's theory of cognitive development, excellence in mathematics requires that one is able to operate at the level of reflective thinking. Greater awareness and emphasis should be given towards greater understanding of the mental processes involved in the learning of mathematics in school.

Inappropriate teaching strategies can also give rise to difficulty in learning mathematics on the part of the students. Skemp (1986) claimed that the learning of mathematics, especially in its early stages and for the average students, is very dependent on good teaching. To know mathematics is one thing and to able to teach it - to communicate it to those at a lower conceptual level - is quite another, and he believed that it is the latter which is most lacking at the moment. As a result, many people acquire at school a lifelong dislike, and even fear, of mathematics.

Teachers' views and beliefs about learning process, particularly about how students learn mathematics, will influence the kind of teaching strategies that they will use in class. Many studies have shown that students are not equipped with necessary knowledge, skills, beliefs, and motivation to approach new problems and learning tasks in an efficient and successful way (De Corte, 1995). Greeno (1991) summarised the prevailing learning activities as follows:

"*In most schools, what students mostly do is listen, watch and mimic things that the teacher and the textbook tell and show them. If students' epistemologies are influenced at all by the experiences they have, then most students probably learn mathematics knowledge is a form of received knowledge, not something that is constructed either personally or socially.*"

Teachers who view learning activity as a passive process on the part of the students will adopt teaching strategy where students play a passive role in class.

Teacher plays the active role of transmitting the knowledge, and the students' job is to record and absorb a collection of pre-specified mathematics facts, rules and procedures. The approach used is mostly rote-memorising, procedural and instrumental learning. On the other hand, another view is that students play the active role in learning process. Students actively negotiate and construct meaning, and build up knowledge by connecting to the earlier knowledge structure that they have constructed. Learning, viewed in this perspective, will lead teachers to use a different strategy in classroom, where the role of the teacher will be more of a facilitator than a transmitter in the learning process.

Students have their own preferred ways learning, or learning styles. Learning styles are stable characteristics of individuals. When engaging in learning tasks or activities, individuals will consistently use their preferred learning styles. This research will look into the subject of learning styles and how they affect performance in mathematics. For this research, the researcher will focus on the model of learning styles that was proposed by Kolb (1985).

According to Kolb's model of learning styles, individuals perceive information on a continuum ranging from concrete experience to abstract conceptualisation, and they process information on a continuum ranging from active experimentation to reflective observation.. Concrete experience, abstract conceptualisation, active experimentation, and reflective observation are the four modes of learning in the Kolb's model.

Kolb (1985) identified four learning styles, and proposed these four names to describe learners according to their learning styles: Converger, accommodator, diverger, and assimilator. Convergers are individuals who have the ability to apply ideas through hypothetical-deductive reasoning. Their modes of learning are abstract conceptualisation and active experimentation. These learners like learning activities that involve abstract ideas and concepts, and they like to do things and play an active role in the learning activities.

Accommodators are individuals who are able to adapt to new situations, and are able to solve problems through trial and error method. Concrete experience and active experimentation are their modes of learning. These learners like learning activities that involve concrete objects and situations, and they take an active part in the class.

Divergers are individuals whose modes of learning are concrete experience and reflective observation. They are reflective in nature, and are good at exploring concrete situations from many angles. Being reflective in nature, they usually do not like to do things and do not play an active role in the learning process.

Assimilators are individuals who are good in overcoming problems through inductive reasoning. Their modes of learning are abstract conceptualisation and reflective observation. High achievers in mathematics are usually convergers and assimilators who have abstract conceptualisation as their mode of learning. These learners are very good in dealing with abstract ideas and concepts.

1.2 Research Objective

The objective of the research is to investigate and seek reasonable answers to the problem of difficulty in learning mathematics as experienced by many students in secondary schools in Malaysia. Particularly; this research seeks to study why many students, including those good selected students studying in premier fully residential schools, fail to perform satisfactorily in mathematics, especially additional mathematics, at form five level.

The problem of students failing in mathematics can be attributed to many factors. Some people like to blame the schools for their bad management, lack of facilities, and school environments which are not conducive for learning. Others may put the blame on teachers for their ineffective ways of teaching. There are also people who do not like to blame anybody because they believe mathematics is indeed difficult, and it is a subject for the gifted few. The root of the problem may be the students themselves because they are lacking in self-discipline and lazy, or because they just do not have the mental aptitude to learn the subject.

The focus of this research is on the students. The purpose of the research is to look into the factors within the students, and to study how these internal factors are related to the students' achievements in mathematics. The following internal factors will be considered as independent variables, which influence the students' level of achievements in mathematics:

- Psychological readiness: Many students have difficulty in learning mathematics because in their minds they have developed a psychological blockage or barrier towards the subject. These students are not psychologically ready to learn mathematics. Psychological readiness will be studied on these four aspects:

  I) Students' attitudes towards the subject

  II) Mathematics anxiety

  III) Motivation to learn mathematics

  IV) Personality and behavioural characteristics such as hardworking, finishing work on time, self disciplined, obedient, patient and compulsive/reflective personality.

Four tests, in the form of questionnaires will be conducted to determine the scores of the four sub-variables above. The questionnaires will be in the form of likert scale. The respondents will be asked to choose whether they strongly agree, agree, uncertain, disagree or strongly disagree to the question asked. High scores in each of the four tests indicate that the respondents have positive attitudes towards learning mathematics, low level of mathematics anxiety, high motivation, and positive personality and behavioural characteristics.

Psychological readiness is the sum of the scores of the four tests. High scores indicate that the students are psychologically ready to learn mathematics.

- Cognitive ability: According to Piaget's theory of cognitive development, children by the age of 11 will move from the level of concrete operational into the level of formal operational. At this level of cognitive development, children are able to operate in logical and abstract thinking. Tests will be carried out to determine whether students in secondary schools (form 4 and 5) have fully matured into the formal operational level of cognitive development. Because of the logical, abstract and conceptual nature of mathematical knowledge, the ability to learn mathematics depends on the mental ability of the students to think and operate beyond the concrete level. Cognitive ability test will be carried out. The test will include items which are related to numerical, abstract reasoning and logical thinking abilities.

- Learning styles: This research seeks to determine whether students' learning styles are related with their mathematics achievements. Researchers in this field have identified many learning styles such global/analytic, left brain/right brain, and field dependence/field independence. For this research, the researcher will focus on learning styles as proposed by Kolb (1985). According to Kolb (1985), learners can be grouped into these four learning styles: Accommodator, diverger, assimilator and converger. Kolb's learning styles inventories will be used to determine students' learning styles. After identifying students' learning styles, correlation tests will be carried out to determine whether learning styles are related to achievements in mathematics.

- Students' learning strategies: This research will look into strategies that students use in the process of acquisition of mathematical knowledge. The strategies which will be investigated are rote learning strategy, algorithmic/procedural learning strategy, surface and deep processing strategy, and meaningful learning strategy. Tests will be given to determine which particular strategy that a student uses in learning mathematics. The relationship between learning strategies and mathematics achievements will be analysed.

1.3 Statement of Research Problem

The focus of this research is on the internal characteristics of the students, and the influence of these internal characteristics on mathematics achievements. The internal characteristics include the psychological and cognitive aspects of the students. The difficulties that the students encounter in learning mathematics can be attributed to the unfavourable internal characteristics within themselves. They are not psychologically and cognitively ready to learn mathematics. The problem of the research is to identify these internal characteristics and determine whether relationships exist between these internal characteristics and the students' achievements in mathematics.

Seven internal characteristics have been identified, and they are listed below. The first four characteristics are psychological and the other three are cognitive in nature. These are the seven factors which will be studied with regard to their relationships with mathematics achievements.

1. Attitudes toward mathematics
2. Mathematics anxiety
3. Motivation to learn mathematics
4. Personality and behavioural characteristics
5. Cognitive readiness.
6. Students' learning strategies.
7. Students' learning styles.

Respondents for the research will comprise of three non-homogenous groups: Very excellent students, good students and weak students. Besides analysing relationships between achievements in mathematics and the seven variables above, comparative analysis will also be carried out to determine whether there are significant differences in the scores of the seven variables above among the three groups. The dependent variable for this research is the students achievements in mathematics (SAM). SAM is determined by the scores that the students get in the Trial Sijil Peperiksaan Malaysia (SPM) Examination for mathematics and additional mathematics. SAM will be the mean of the two scores. Trial examination is given in about two months before form five students sit for the real SPM examination in November.

The research problem can be broken into seven research questions:

RESEARCH QUESTION 1:

Does relationship exist between students' achievements in mathematics (SAM) and their attitudes towards mathematics?

Comparative analysis: Do students in the three groups show significant differences in their attitudes towards mathematics?

RESEARCH QUESTION 2:

Does relationship exist between SAM and students' level of mathematics anxiety?

Comparative analysis: Do students in the three groups show significant differences in their level of mathematics anxiety?

RESEARCH QUESTION 3:

Does relationship exist between SAM and students' level of motivation to study mathematics?

Comparative analysis: Do students in the three groups show significant differences in their level of motivation to study mathematics?

RESEARCH QUESTION 4:

Does relationship exist between SAM and students' personality and behavioural characteristics such as hardworking, finishing work on time, self disciplined, obedient, patient and compulsive/reflective personality?

Comparative analysis: Do students in the three groups show significant differences in their personality and behavioural characteristics?

RESEARCH QUESTION 5:

Does relationship exist between SAM and students' scores in cognitive readiness test?

Comparative analysis: Do students in the three groups show significant differences in their cognitive readiness test scores ?

RESEARCH QUESTION 6:

Does relationship exist between SAM and students' learning styles ?

Comparative analysis: Do students in the three groups show significant differences in their learning styles?

RESEARCH QUESTION 7:

Does relationship exist between SAM and students' learning strategies?

Comparative analysis: Do students in the three groups show significant differences in their strategies towards learning mathematics?

1.4 Hypotheses

The following hypotheses are made based on the research questions mentioned earlier. For inter-groups comparative analysis, the three groups are labelled as:

Very excellent students group = VESG

Good students group = GSG

Weak students group = WSG

HYPOTHESIS 1:

Students with higher achievements in mathematics will have higher scores in the test of attitudes towards mathematics (higher score means more positive attitudes).

Null hypothesis : There is no significant relationship between SAM and their scores in the test of attitudes towards mathematics.

HYPOTHESIS 2:

Students with higher achievements in mathematics will have higher scores in mathematics anxiety test (higher score means lower level of anxiety).

Null hypothesis : There is no significant relationship between SAM and their scores in mathematics anxiety test.

HYPOTHESIS 3:

Students with higher achievements in mathematics will have higher scores in the test of motivation to study mathematics (higher score means higher motivation).

Null hypothesis : There is no relationship between SAM and their scores in the test of motivation to study mathematics.

HYPOTHESIS 4:

Students with higher achievements in mathematics will have higher scores in the test of personality and behavioural characteristics (higher score means positive personality and behavioural characteristics such as hardworking, always finishing work on time, obedient, patient, and reflective personality).

Null hypothesis : There is no relationship between SAM and their scores in the test of personality and behavioural characteristics.

HYPOTHESIS 5:

Students with higher achievements in mathematics will have higher scores in cognitive readiness test.

Null hypothesis : There is no relationship between SAM and their scores in cognitive readiness test.

HYPOTHESIS 6:

Achievements in mathematics are positively related with abstract conceptualisation mode of learning .

Null hypothesis : There is no significant relationship between achievements in mathematics and abstract conceptualisation mode of learning.

Note: Abstract conceptualisation is the mode of learning of convergers and assimilators. Kolb's Learning Style Inventories (1985) will be used to determine the students' modes of learning and their learning styles.

HYPOTHESIS 7:

Students with high achievements in mathematics will score higher in the test of learning strategies.

Null hypothesis : There is no relationship between SAM and their scores in the test of learning strategies.

Note: Learning strategies range from the very crude method of rote-memorising to the more sophisticated approach of meaningful learning. High scores in the test of learning strategies indicate that the students' strategy in learning is oriented towards meaningful learning.

The following hypotheses, 8 to 14, are for inter-groups comparisons:

HYPOTHESIS 8:

In the test of attitudes towards mathematics, the mean score of VESG is higher than the mean score of GSG, and the mean score of GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the test of attitudes towards mathematics.

HYPOTHESIS 9:

In the mathematics anxiety test, the mean score of the VESG is higher than the mean score of the GSG, and the mean score of the GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the mathematics anxiety test.

HYPOTHESIS 10:

In the test of motivation to study mathematics, the mean score of VESG is higher than the score of GSG, and the mean score of the GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the test of motivation to study mathematics.

HYPOTHEIS 11:

In the test of personality and behavioural characteristics, the mean score of VESG is higher than the score of GSG, and the mean score of GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the test of personality and behavioural characteristics.

HYPOTHESIS 12:

In the cognitive readiness test, the mean score of VESG is higher than the mean score of GSG, and the mean score of GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the cognitive readiness test.

HYPOTHESIS 13:

In the test of mode of learning for abstract conceptualisation, the mean score of VESG is higher than the mean score of GSG, and the mean score of GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the test of mode of learning for abstract conceptualisation.

HYPOTHESIS 14:

In the learning strategies test, the mean score of VESG is higher than the mean score of GSG, and the mean score of GSG is higher than the mean score of WSG.

Null hypothesis : There is no significant differences in the mean scores of the three groups in the learning strategies test.

1.5 Expectations of Research

1. Attitudes towards mathematics:

   High achievers in mathematics have positive attitudes towards mathematics. Attitudes towards mathematics and achievements in mathematics are positively related. Students' achievements in mathematics (SAM) are expected to have a significant and positive correlation with scores in the test of attitudes towards mathematics. For inter-groups comparisons, the mean score of very excellent students group (VESG) is expected to be higher than the mean of the mean of goog students group (GSG), and the mean of GSG is expected to be higher than the weak students group (WSG).

2. Motivation to study mathematics:

   With strong motivation, students are expected to perform better in mathematics. SAM are expected to be positively correlated with scores in the test of motivation to study mathematics. For inter-group comparisons, the mean score in the motivation test of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to higher than the mean score of WSG.

3. Mathematics anxiety:

   High mathematics anxiety will result in poor performance in mathematics. High level of anxiety creates disturbance in the mind and the thinking processes. SAM are expected to correlate positively with scores in mathematics anxiety test. In the mathematics anxiety test, high scores will indicate low level of mathematics anxiety. For inter-groups comparison, the mean score in the mathematics anxiety test of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to be higher than the mean score of WSG.

4. Personality and behavioural characteristics:

   High achievers in mathematics are the ones who have positive personality and behavioural characteristics. SAM are expected to be positively correlated with scores which indicate positive personality and behavioural characteristics. In the personality and behavioural characteristics test, high scores will indicate positive personality and behavioural characteristics. For inter-groups comparisons, the mean score in the personality and behavioural characteristics test of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to be higher than the mean score of the WSG.

5. Cognitive readiness:

   Cognitive readiness test will give scores which will indicate the students' ability to perform operations involving numerical, quantitative, abstract reasoning, and logical thinking skills. SAM are expected to have a positive correlation with scores in the cognitive readiness test. For inter-groups comparison, the mean score in the cognitive readiness of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to higher than the mean score of WSG.

6. Learning styles:

   The dominant mode of learning of high achievers in mathematics abstract conceptualisation. SAM are expected to have a positive correlation with high scores in the abstract conceptualisation mode of learning. The learning styles of high achievers in mathematics are convergence and assimilation. For inter-groups comparison, the mean score in the abstract conceptualisation mode of learning test of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to be higher than the mean score of WSG. The number of convergers and assimilators is expected to be larger in VESG than in GSG, and the number convergers and assimilators is expected to be larger in GSG than in WSG.

7. Learning strategies:

SAM are expected to have a positive correlation with high scores in learning strategies test. High scores in learning strategies test indicate that students' learning strategy is oriented towards meaningful learning as opposed to rote memorising. For inter-groups comparison, the mean score in the learning strategies test of VESG is expected to be higher than the mean score of GSG, and the mean score of GSG is expected to be higher than the mean score of WSG.

1.6 Significance of Research

- Mathematics is an important subject. Requirements of admission into institutions of higher learning in Malaysia usually include good grade in mathematics at SPM level. The purpose of this research is to identify factors which influence students' performance in mathematics. By understanding these factors, efforts can be made to overcome these factors in order to raise the performance of students in mathematics.

- Factors within the students are the focus of this research. Teachers and students themselves can act on these factors so that they (the students) will be better learners of mathematics.

- This research will identify characteristics of students who are good and weak in mathematics. By understanding these characteristics, students will know what it takes, and what changes they need to do within themselves, in order to succeed in learning mathematics.

- The instruments used in the research can be used for diagnostic purposes. and from here remedial programs can be formulated for students who are weak in mathematics.

- Students' achievements in mathematics (SAM) are dependent on these seven variables: Attitudes towards mathematics (s), motivation (t), mathematics anxiety (u), personality and behavioural characteristics (v), cognitive readiness (w), learning styles (x), and learning strategies (y). Through multiple regression analysis, an equation which relates SAM to the seven variables can be obtained.

  $SAM = f(s,t,u,v,w,x,y)$

The equation above can be used for prediction purposes. The instruments of the research can be given to students, and after knowing the scores of the seven variables, we can predict how these students will perform in mathematics by using the above equation.

- The findings of this research can be used to formulate programs in secondary schools to help students achieve better performance in mathematics.

1.7 Definition of the Main Terms

1. ATTITUDES

An internal state within a person which causes the person to give a consistent respond, either positively or negatively, towards other persons, objects, situations, events, or ideas. This internal state includes the person's beliefs and feelings towards the object or situations, and these beliefs and feelings determine how the person will respond towards the object or situation.

2. MOTIVATION

It is a force within a person which energises, sustains, and directs behaviour towards performing a task or achieving a goal. Motivation, which can be either extrinsic or intrinsic, energises and drives an individual towards achieving a goal.

3. MATHEMATICS ANXIETY

A state or condition where a person experiences feelings of uneasiness, tension and fear when the person is in a mathematics class or performing learning tasks involving mathematics. Besides feeling tensed and uneasy, the person may be in unpleasant physical conditions such increasing heart beat and sweaty palms.

4. COGNITIVE READINESS

To learn mathematics successfully, the students must be ready cognitively for the subject. Mathematics is abstract and conceptual in nature. The students cognitive development must be in the formal operational stage. At this stage, students are able to think logically, and are able to understand abstract concepts and ideas.

5. LEARNING STRATEGY

It is an approach that students use in order to learn and acquire new knowledge and information. The strategies can change according to situations and types of learning tasks. Students' ways of learning can range from the very crude method of rote-memorising to the more sophisticated method of meaningful learning.

6. LEARNING STYLES

It refers to the habits of individuals in the ways they consistently perceive and process information in a learning situation. These habits are stable characteristics of individuals. Individuals may prefer to perceive and process information sequentially part by part or in whole.

7. ACCOMMODATORS

These are individuals whose learning style is characterised by concrete experience and active experimentation. They perceive information through concrete experience which involves relating to personal experience, feeling, and intuition. They process information by actively doing things and experimenting with the new ideas.

8. DIVERGERS

Like accommodators, divergers perceive information through concrete experience. However, when it comes to processing, they are more reflective in their approach. Their mode of processing is reflective observation

9. CONVERGERS

Convergers are individuals who perceive information through abstract conceptualisation. These individuals are competent at learning abstract ideas and concepts. Like accommodators, their mode of processing information is through active experimentation.

10. ASSIMILATORS

Assimilators are good at learning abstract concepts and ideas, and they are reflective in nature. Their style of learning is characterised by abstract conceptualisation and reflective observation.

CHAPTER 2

LITERATURE REVIEW

2.1 Attitudes Towards Mathematics

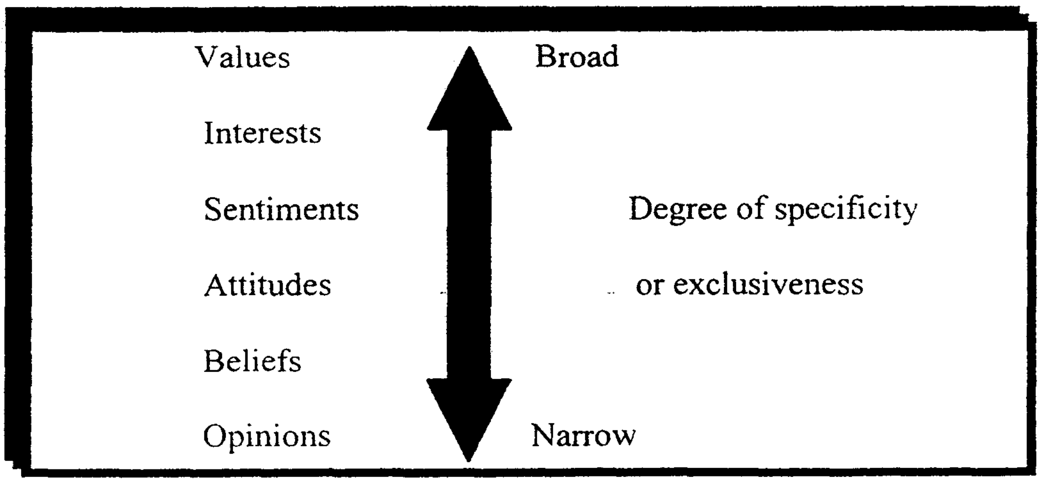
In the early study of attitude, it was viewed as a simple concept, which is the amount of affect a person has for or against an object. Later, Allport (1935), proposed a broader definition: " Attitude is a mental and neural state of readiness to respond, organised through experience, and exerting a directive and/or dynamic influence on the behaviour". Ajzen (1988) defines attitude as "a disposition to respond favourably or unfavourably to an object, person, institution or event".

Triandis (1971) and Ajzen (1988) view attitude as a multi-dimensional construct with the following three interwoven components:

- Cognitive : Expressions of beliefs about an attitude object.
- Affective: Expressions of feelings towards an attitude object.
- Conative: Expressions of behavioural intention.

There has been much discussion about this multidimensional construct with regard to belief. Silver (1985) and Schoenfield (1985) (cited in McLeod, 1989, p.32) expressed the view that belief systems lie on the border between cognition and affect, whereas Oppenheim (1966) views beliefs as being in the upper layer of consciousness, with attitudes and values being in the lower levels.

Encyclopaedia Britannica (1978) defines attitudes as pre-dispositions to classify sets of objects or events and to react to them with some degree of evaluative consistency. Attitudes are not objectively observable, but they can be inferred through responses to questionnaires, gross behaviours and physiological symptoms. An attitude is more enduring than a mood or whim, and the response that it produces is consistent. The difference between attitude and other terms such as value, interest, sentiment, belief and opinion is one of the degree of specificity or exclusiveness rather than of kind. Attitudes are viewed as more narrow pre-dispositions when compared to values, interests and sentiments. Beliefs and opinions are more narrow or specific when compared to attitudes. This is illustrated in the box below:



Aiken (1985) contended that attitudes towards mathematics begin developing as soon as children are exposed to the subject, but the age of 11 to 13 years appears to be particularly important. He claimed that this is the time when negative attitudes towards mathematics become very noticeable. It is not clear whether the increase in negative attitudes at this stage of development is due to greater abstractions of the mathematical knowledge to be learned, to social or sex preoccupation, or to some other factors.

Goodlad (1984) studied more than 17,000 young students regarding their attitudes towards mathematics. The study found that mathematics was rated the same as reading in a list of subjects which they like, after art and physical education. Carpenter, Corbitt, Kepner, Lindquist, and Reys (1981), in the National Assessment of Educational Progress, found that 9-year old students ranked mathematics as their best-liked subject; 13-year old students ranked it second best; and 17-year old students, in contrast to the younger students, ranked it as their least-liked subject.

These research studies indicate that children are not born with negative attitudes towards mathematics. Instead, negative attitudes towards mathematics develop over time, especially during adolescent years. Many research studies on attitudes towards mathematics have shown that significant declines in positive attitudes towards mathematics occur during adolescent years (Brush, 1979; Wigfield & Eccles, 1994; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991).

Cheung (1988), in his study of mathematics achievement and attitudes towards mathematics among form one students in Hong Kong, found that mathematics achievement and attitudes towards mathematics are related. He found that mathematics achievement was highly correlated with these three attitude components:

- Mathematics and myself : A measure of the students' own estimation of their abilities in doing mathematics.

- Mathematics and society : A measure of the students' perception of the usefulness of mathematics in society.

- Mathematics and create : A measure of the students' perception of mathematics as a creative subject.

Promoting students' attitudes in these dimensions is likely to result in an increase in mathematics achievement in subsequent years of schooling. He suggested that more emphasis should be given in fostering favourable attitudes as a means to enhance mathematics achievement, especially for under-achievers.

In Thailand, Kreangsak Prowsri and Dr. Prapon Jearakul (1986) investigated the relationships of several variables to mathematics achievements of Thai school students. The variables that they investigated were logical thinking ability, sex, home background, attitude towards mathematics and interest in mathematics. They found that logical thinking ability, attitude towards mathematics and interest in mathematics correlate significantly with mathematics achievement.

2.2 Motivation to Study Mathematics

According to Encyclopaedia Britannica (1978), the word motivation originated from Latin word, motivus, which means a moving cause. Motivus is derived from Latin word, motus, which means moved. Motivation refers to the causes of behaviour, which are whatever within the individual that incite action. Success is usually associated with high motivation, whereas failure is due to lack of motivation. Motivation is an internal condition which drives a person to achieve his goal. A person with high motivation will show characteristics such as high energy, sense of direction, commitment and strong determination.

According to Baron (1992) and Schunk (1990), motivation is a force that energises, sustains, and directs behaviour towards a goal. Researchers have found that motivation and achievement have a strong and positive correlation (Pintrich & Schunk, 1996; Wang, Hartel, & Walberg, 1993). Students who are motivated are always eager to learn, give more effort, and persist in the face of difficulty (Stipek, 1996).

Motivation can be categorised into two types – extrinsic and intrinsic motivation. According to Pintrich & Schunk (1996), extrinsic motivation refers to motivation to engage in an activity as a means to an end, whereas intrinsic motivation is motivation to engage in an activity for its own sake. Extrinsically motivated students study because of some external rewards such as high grades or compliments from others. On the other hand, intrinsically motivated students study because they find learning enjoyable and worthwhile.

Extrinsic and intrinsic motivation vary with different situations, and change over time. Ideally, students should be intrinsically motivated. Research has shown that students who are intrinsically motivated achieve higher than those who are extrinsically motivated (Gottfried, 1985). Giving rewards to motivate students should be done with caution because research has indicated that offering rewards for engaging in intrinsically motivating tasks decreases interest in the task (Desi & Ryan, 1987; Schwartz, 1990).

Hull (1943) viewed motives as internal states that set behaviour in motion. Central to his viewpoint are these two concepts: Needs and drives. A need is the lack of a biological essential like food or water. A drive is the state of tension or arousal produced by a need. When a need arises, a person experiences a drive. When experiencing a drive, the person's internal state gets out of balance. The person feels tensed and aroused, and this condition urges the person to find appropriate actions in order to satisfy that need.

According to Hull (1943), there are two types of drives: Primary and acquired. Primary drives are drives within individuals that are triggered by biological needs. Acquired drives are drives acquired through a process of association with primary drives. They are like desires for wealth, love or music. All psychological motives are acquired drives.

2.2.1 Human Needs

Murray (1938), who studied human motivation, identified several human needs. According to him, people differ in the characteristics and strength of their needs. For example, some people have strong need for achievement and a weak need for dominance. The strength and combination of needs that people have are usually not the same. In response to these needs, people are driven to behave in various ways and patterns so as to satisfy the needs. Below is the list of 21 human needs as identified by Murray:

1. Abasement : Need to submit to external forces, to comply, to accept punishment.
2. Achievement : Need to accomplish, to overcome obstacles, and to do something difficult.

3. Affiliation : Need to form and maintain friendship, to live with others, to co-operate, and to love.

4. Aggression : Need to overcome opposition, to assault, to injure, to belittle or accuse another person.

5. Autonomy : Need to be free of restraint, to resist influence, and to defy authority.

6. Counteraction : Need to make up for failure, to refuse defeat, and to defend honour.

7. Defensive : Need to defend against criticism, to justify one's action, to offer explanations and excuses.

8. Deference : Need to admire a superior, to co-operate with a leader, and to serve another person.

9. Dominance : Need to control one's environment, to persuade, to lead and direct.

10. Exhibition : Need to make an impression, to attract attention to oneself, and to excite others.

11. Harm-avoidance: Need to avoid physical harm, to escape danger, to take precaution,

12. Inferior-avoidance : Need to avoid humiliation, to avoid failure, and to hide shame.

13. Nurturance: Need to assist the helpless, to express sympathy, to nourish another.

14. Order : Need to put things in order, to be tidy, and to act precisely.

15. Play : Need to have fun, to seek diversion, and to laugh.

16. Power : Need to have an impact on others. to be in charge of people and situations.

17. Rejection : Need to snub, to reject. and to be aloof.

18. Sentience : Need to seek and enjoy sensuous feelings.

19. Sex : Need to form and maintain an erotic relationship. and to have sexual intercourse.

20. Succourance : Need to have one's need gratified by another. to seek aid. and to be dependent.

21. Understanding : Need to ask and answer questions. to analyse experiences. and to discriminate among ideas

2.2.2 Hierarchy of Needs

There are various motives that arouse and drive people to behave in some particular ways or patterns. An attempt was made by Abraham Maslow (1970) to systemise human motives, and he suggested that human motives are arranged according to a hierarchy of needs, as illustrated in figure 2.1 .

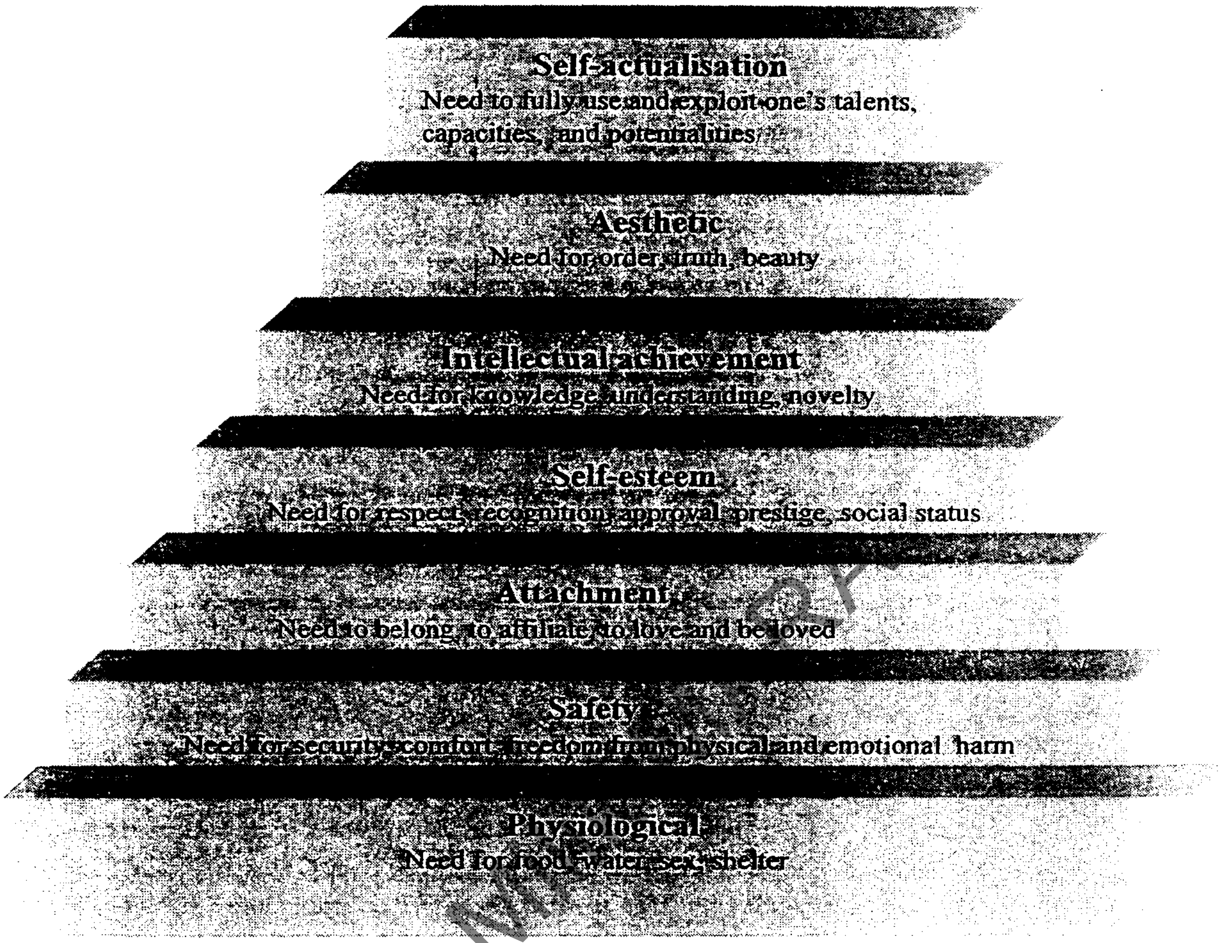


Figure 2.1 Maslow's Hierarchy of Needs

According to Maslow (1970), people have a variety of needs which can be arranged in a hierarchy according to the order in which they are satisfied. Needs at the bottom of the hierarchy must be satisfied first before higher needs can arise and be attended to. People who do not have food and shelter, for example, will not be concerned with higher needs like attachment or self-esteem.

The needs in the bottom four -- physiological, safety, attachment and self-esteem -- are categorised as deficiency needs. These needs, when deficient or unfulfilled, energise and drive people to satisfy them. Until these needs are fulfilled, people are not likely to move to higher ones

When these deficiency needs are fulfilled, higher needs in the top three of the hierarchy will become relevant and be attended to. The needs in the top three of the hierarchy -- intellectual achievement, aesthetic and self-actualisation -- are called growth needs. According to Maslow, people respond to growth needs differently than they do to deficiency needs. Unlike deficiency needs which can be met or fulfilled, growth needs can never be satisfied. This is because growth needs always expand and grow as people have experiences with them. For example, in intellectual achievement need, when a person understands a particular area of knowledge, his or her desire to know and learn more of that knowledge increases or keeps growing. Thus, the need is called growth need.

In his study of self-actualisation, Maslow (1968) found that people, who have first fulfilled their deficiency needs, move on to higher needs and strive for self-actualisation. However, very few of these people, less than one percent, ever reach the level of self-actualisation. Among individuals whom Maslow studied and believed to be self-actualised are Thomas Jefferson, Albert Einstein and Eleanor Roosevelt.

Maslow's work has great implications in the field of education. Children who are tired, hungry or emotionally unstable, will not have the motivation to learn in the classroom. In pursuing academic excellence, students must respond to the to the fifth need in the Maslow's hierarchy of needs, which is the need for intellectual achievement. This need will not be aroused in the students if the lower deficiency needs are not fulfilled first.

Teachers should create learning environment where students feel free from physical or emotional harm. Blumenfield (1992), Brophy and Good (1986) and McCombs (1998) found that students who feel threatened by potential embarrassment or who work in an unsafe and disorderly environment, are less motivated to learn and achieve less than those who learn in stable and safe environment.

2.2.3 Achievement Motivation

Achievement motivation has been the object of much discussion and research among educational psychologists. Achievement motivated students are the ones who perform excellently in their study and stand up as high achievers in schools. Achievement motivation is the need to accomplish something difficult in situations that are characterised by a standard of excellence (Murray, 1938). It is a drive to excel in learning tasks and the capacity to experience pride in accomplishment (Atkinson, 1980, 1983).

According to Atkinson (1980), it is important that achievement motivation is aroused in students because it will direct students toward accomplishment of academic excellence, and at the same time it will reduce the need to avoid failure. Achievement motivated students like challenging tasks, high grading standards, and opportunities to try their best in testing situations. In contrast, students who are motivated because of a need to avoid failure tend to avoid challenging tasks, experience anxiety in tests, prefer easy grading, and seek protection from embarrassment for failure.

Academic achievement depends very much on the students' conviction of being in charge of their own fate. High achievers ascribe their accomplishments to their own personal decisions and efforts. Low achievers often blame impersonal, fatalistic forces such as luck and other people for their failures (Coleman et al., 1966). Many high achievers ascribe to the following expressions:

Success is 10% inspiration and 90% perspiration.

Nothing comes easy.

A fool blames failure on others, a wise man on himself.

Weiner (1986), in his attribution theory of motivation, attempted to systematically describe explanations for success and failures in schools. Attributions are explanations or perceived causes by students for their successes or failures. Students seek to understand why they succeed or fail. They may attribute their success or failure to various factors such as ability, effort, luck, task difficulty, wrong strategies, mood, clarity of teaching and support or help from teachers and others. Ability, luck, effort and task difficulty are most common attributions (Weiner, 1990).

According to Weiner (1986), attributions can be described on three different dimensions:

1. Locus of causality -- the origin can be inside or outside the person. Ability and effort are inside, whereas luck and task difficulty are outside.
2. Stability -- whether the causes stay the same or can change. Effort and luck are unstable, because they can change, whereas ability stays the same.
3. Controllability – whether the causes can be controlled or not. Ability, luck and task difficulty are beyond our control, whereas effort is within our control.

Weiner believes that students' causal attributions will influence their future efforts to succeed at any given task. Attributing failure to lack of effort is likely to improve future performance, whereas attributing failure to lack of ability decreases future performance (Weiner,1994). Students who attribute their performance to causes that are internal, unstable(changeable), and controllable such as lack of effort are motivated to succeed in future because they believe they can make the necessary changes within themselves, such as putting more effort. On the other hand, attributing failure to causes which are external, stable, and uncontrollable, decreases motivation to undertake and succeed at similar tasks in the future.

Achievement motivation is very much dependent on students' judgement of their self-efficacy towards the particular learning task. Bandura (1995) refers self-efficacy as a belief in one's capabilities to organize and execute the actions necessary to manage particular situations. According to Zimmerman (1995), self-efficacy is a content-related judgement and in academic, it refers to the students' beliefs that they can perform a particular learning task successfully. Self-efficacy is subject specific. For example, a student may have high self-efficacy for language and writing but low self-efficacy for mathematics.

Self-efficacy is an appraisal or evaluation that students make about their capability to succeed at a particular learning task. According to Bandura (1986) and Schunk (1991), students' judgements of their self-efficacy are derived from these four sources of information:

(i) Actual experience:

Past experiences, whether successes or failures, are important indicators for students when making judgements about their self-efficacy. Students, who have always experienced failures in a particular subject, will have low self-efficacy for the subject. Successes will raise self-efficacy on the condition that the students do not attribute these successes to external factors such as good luck, getting help from others, and the tasks were easy or unchallenging. Their self-efficacy will be higher if they feel that they have succeeded in undertaking a challenging task through their own effort, hard-work, and without much help from others. Success will not promote self-efficacy if students perceive the task to be easy, or not much effort has been put in for the task (Early & Lituchy, 1991).

(ii) Vicarious experience (Modelling effect):

Learners, who have watched their peers successfully performing a task, will experience an increase in their self-efficacy for the task. Bandura (1986) claimed that vicarious experience is most influential in situations in which individuals have little personal experience with the task. Schunk and Hanson (1985) studied self-efficacy of two groups of children for a task. One group observed their peers and the other group observed their teacher, each successfully performing a similar task. They found that the children who observed their peers had a higher self-efficacy for the task compared with the children who observed their teacher. This shows that modelling effect on self-efficacy is high if it is done by peers.

(iii) Verbal persuasion and encouragement:

Students' self-efficacy can be increased if they are given verbal persuasion and encouragement by their teachers or other persons who are perceived as credible by the students. Students need to be persuaded and encouraged that they can succeed in any particular learning task. However, the task must be realistic, and teachers should give proper guidance and supervision to make sure that the students' efforts end up in success. If their efforts end up in failure, the effect on self-efficacy will be negative.

(iv) Physiological arousal:

Students who experience symptoms of anxiety like increased heart-beat and sweating palms while undertaking a task, may interpret them as signs that they lack ability in performing the task. These physiological symptoms may lead them to lower their self-efficacy for the task.

Students who are weak in mathematics have low self-efficacy for the subject. They have always experienced failures in tests and examinations given by their mathematics teachers. The gradual decrease in self-efficacy as a result of these continuous failures will lead to learned helplessness. Learned helplessness is the feeling that no amount of effort can lead to success (Seligman, 1975). These students believe that there is nothing they can do to avoid failure. They begin to develop feelings of shame and self-doubt. As a result they give up without trying and may completely abandon the subject. To help these students overcome their feeling of helplessness, Seligman (1995) recommends "immunising" them against the feeling of helplessness by providing them with successful mastery experiences.

According to Dweck & Goetz (1978), students who experience learned helplessness, attribute their failures to their low ability, which they believe is beyond their control. In doing their schoolwork, these students give little effort, and give up very easily when they encounter difficulty. Some of the behaviours which indicate learned helplessness are:

1. Does not pay attention to teacher.
2. Does not ask question.
3. Does not ask for help, even when needed.
4. Appears bored and uninterested.
5. Seems disengaged from classroom activities.
6. Does not show pride in successes.
7. Gets discouraged easily.

2.3 Mathematics Anxiety

To mathematics teachers, they often hear their students making statements such as follows when these students confront learning tasks involving mathematics:

(i) When I look at mathematics problem, my mind goes blank. I feel stupid, and I cannot do even the simplest calculations.

(ii) I tried hard to solve math problems, but I always failed to get the right answers. This makes me crazy.

(iii) In math tests and examinations, I always feel terrified. My palms become sweaty, my heart-beat becomes very fast, and I cannot even make my eyes focus on the question paper.

(iv) I find math difficult to understand. I do not understand what the teacher is saying, and my mind just wanders away from the subject.

(v) Some people can do mathematics, but not me.

The statements above are expressions of mathematics anxiety, which is a feeling of frustration and helplessness about their ability to learn and do mathematics. Mathematics anxiety can be defined as " feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Spielberger (1972) identified two types of anxiety: State and trait. State anxiety is a relatively stable condition which resides in a person at all times. It is a stable personality characteristic of a person. Trait anxiety, on the other hand, is a temporary emotional state. It is aroused at specific times and in specific situations. It is accompanied by reactions like increased heart-beat, sweaty palms and muscle tension. Mathematics anxiety is generally accepted as trait anxiety.

Anxiety can be either facilitative or debilitative. Facilitative anxiety motivates an individual to succeed in a task, whereas debilitative anxiety inhibits an individual from performing successfully in a task. A moderate amount of anxiety can facilitative, but beyond a certain point, anxiety can be debilitative. Relatively high anxiety improves performance on simple, well-practised tasks but lowers performance on new or difficult tasks (Covington & Omelich, 1987).

There are two components of anxiety: Cognitive and emotional (Sarason & Sarason, 1990). The cognitive components include expectations for success and concerns about one's performance. This component is believed to interfere most directly with learning and performance (Sarason & Sarason, 1990; Tobias, 1992).

The emotional component refers to the autonomic physiological reactions that are evoked by the stressful situations (Holroyd & Appel, 1980). Some of the physiological symptoms of highly anxious persons are shown in figure 2.2.

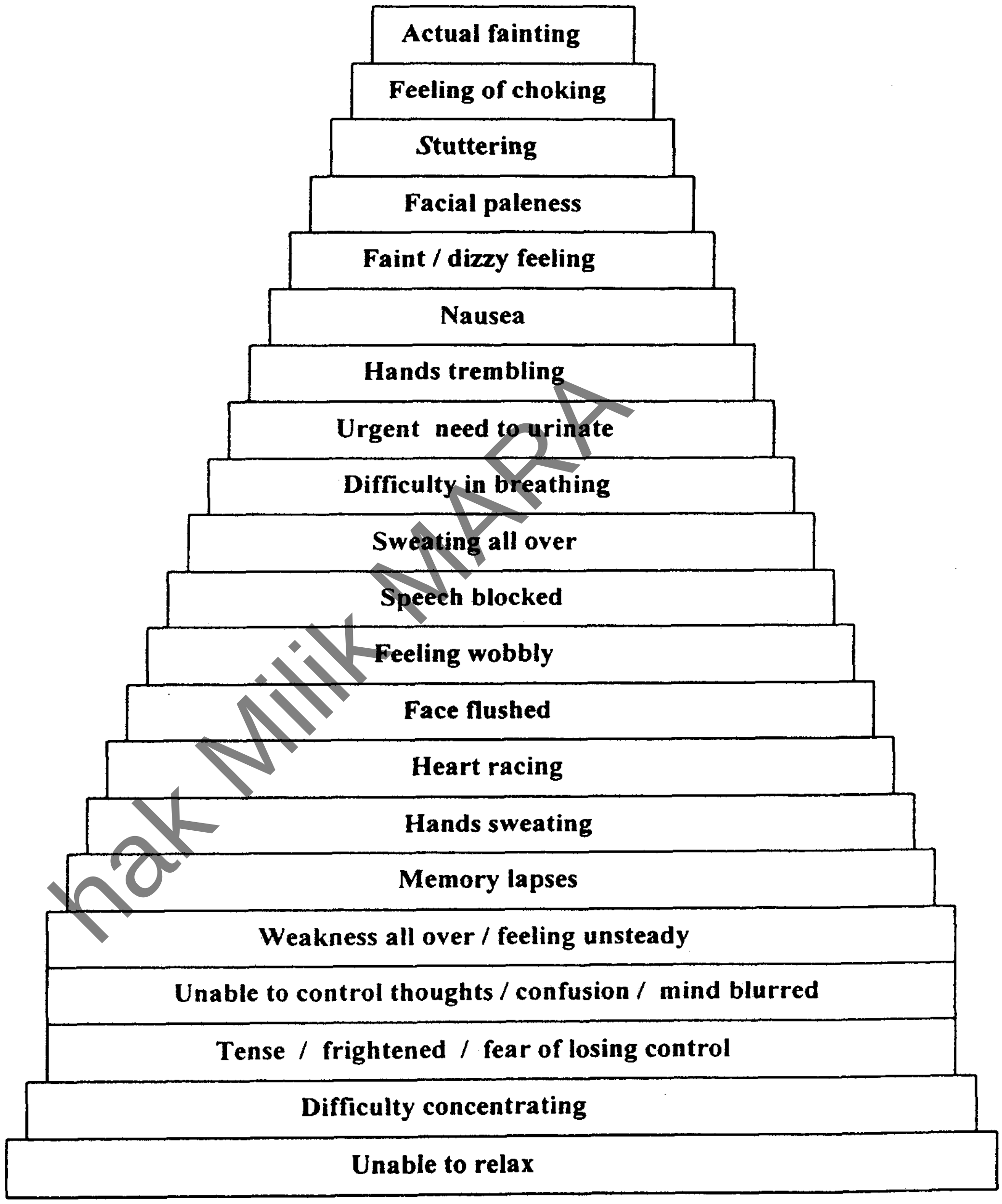


Figure 2.2 Symptoms of High Anxiety

(In increasing order of severity from bottom to top)

Some of the negative effects of mathematics anxiety include avoidance of mathematics (Hembree, 1990) and interference with conceptual thinking and memory processes (Skemp, 1986). There appears to be a negative relationship between mathematics anxiety and achievement in mathematics (Hembree, 1990). Richardson and Suinn (1972) found a strong negative correlation between mathematics anxiety and mathematics achievement in college students. Children who are under-achievers in mathematics are significantly more mathematics anxious than achievers and over-achievers (Sepie & Keeling, 1978). Although causal direction of the association between achievement and anxiety is ambiguous and complex, it is generally accepted that anxiety interferes with learning and with the ability to demonstrate understanding.

According to Tobias (1992), anxiety interferes with learning and performance at three levels. First, anxiety inhibits efficient pre-processing of new information. Pre-processing refers to how the learner registers and internally represents new input. Second, anxiety interferes with processing, which refers to how learners organise, analyse information, and use it to generate solutions to problems. Third, anxiety interferes with the output, which refers to the ability of the learners to reproduce the knowledge that they have learned at later times, such as during tests.

At the pre-processing and processing level, high-anxious students have less effective study skills than low-anxious students (Topman, kleijn, van der Ploeg, & Masset, 1992). Benjamin, McKeachie, Lin, and Holinger (1981) found that high-anxious college students spent more time studying than low-anxious students, but they had more problems in learning the material. These high-anxious students had problems in analysing and organising information that was in front of them.

At the output level, high anxiety can result in students experiencing confusion in their thoughts, which they usually describe as their mind went blank or having mental blockage. High-anxious students devote significant amounts of attention to task-irrelevant thoughts (Wine, 1980). High-anxious students are preoccupied with "worrying" about their performance, and this interferes with their abilities to retrieve information and demonstrate their skills and knowledge (Sarason & Sarason, 1990; Schwarzer & Jerusalem, 1992; Tobias, 1992). Bandura (1988) claimed that these students are too preoccupied with the thoughts of their deficiencies, and they envision failure in undertaking challenging learning task. These negative thoughts and physiological effects of high anxiety, such as sweaty palms and trembling hands, can interfere with their performance.

Mathematics anxiety, or sometimes called math-phobia, is widespread (Lazarus,1975). Children are not born with mathematics anxiety. Instead, it develops over time, especially during adolescent years. Mathematics has been causing much anxiety in many older students and adults. College students are more anxious about mathematics than English or social science (Everson, Tobias, Hartman, & Gourgey, 1993), or writing (Sapp, Farrell, & Durand, 1995).

Approximately about one-third of college students suffer from some level of mathematics anxiety (Anton & Klisch, 1995).

There are various possible causes of mathematics anxiety in students. Lazarus (1975) argued that mathematics anxiety results from poor instruction and poorly designed mathematics curricula. Mathematics curricula are cumulative and hierarchical in nature. As a result, if students fail to understand one operation, then they are unable to learn anything taught beyond that operation.

According to Greenwood (1984), teachers can create anxiety by placing too much emphasis on memorising formulae, learning through drill and practice, applying rote-memorised rules and teaching the "traditional" way. The traditional way of teaching refers to the mechanical "explain-practice-memorise" teaching method, emphasising memorisation rather than understanding and reasoning. Rote-memorised rules and manipulations of symbols with little or no meaning are harder to learn than an integrated conceptual structure (Skemp, 1986).

Stodolsky (1985) attributed mathematics anxiety to poor teaching method and negative experiences in the classrooms. She claimed that mathematics teaching is very much teacher-centred, and this fosters in students the belief that mathematics is something that is learned from an authority, and cannot be figured out on their own. In mathematics classes, she found that the teaching format, the materials used, and the activities that the students went through were more similar from day to day compared to classes in other subjects. can create anxiety because some students may prefer to learn. instructional formats.

According to Stodolsky (1985), the characteristics of mathematics classes were:

1. A recitation and seatwork pattern of instruction.

2. A reliance on teacher to present new concepts or procedures.

3. Teaching and learning were centred on textbook.

4. Textbook lacked material for concept development

5. Lack of manipulative materials.

6. Lack of small-group works and discussions.

The innate characteristics of mathematics, which are full of abstract concepts, symbols, operations, and rigorous logical reasoning, can create anxiety in many students because they cannot understand it. The abstract and conceptual nature of mathematics makes mathematical comprehension difficult for many students. Stodolsky (1985) suggested that mathematics is an area in which ability plays a dominant role in one's performance; either one has the ability or one does not. Students may have the belief that if they do not have they ability in mathematics, then they will just have to accept that they are no good in mathematics. Practice and more effort will not change the situation. Mathematics is only for the "gifted" and "geniuses". In contrast, they generally believe that, for other subjects such as in social sciences, they can improve their performance with practice and effort.

At form 4 and 5 level, many students find mathematics difficult to understand. Active learning, the novelty and difficulty of solving non-routine problems, which require high-level computational skill and thinking processes, will give rise to intense affective responses such as anxiety (McLeod, 1993). Under such intense learning situation, teachers should provide the necessary positive, supportive atmosphere where students feel at ease to discuss, ask questions and take risks without fear of criticism.

Encouraging students to discuss and work with their peers in small co-operative and supportive groups may have important affective consequences, including reducing anxiety (von Glaserfield, 1991). Bush (1991), in his study of mathematics anxiety among upper elementary school students, found that mathematics anxiety tended to decrease as teachers spent more time in small group instruction, with more experienced teachers, and with teachers who had taken more post-bachelor's mathematics courses. Greenwood (1984) suggested that discussion of various strategies for solving mathematical problems is important in reducing mathematics anxiety.

2.4 PERSONALITY AND BEHAVIOURAL CHARACTERISTICS

According to Skemp (1971), mathematics is a hierarchical build-up of concepts. New concepts are developed through a process of abstraction and generalisation of earlier concepts. Students will have problems learning new concepts if, at the earlier level, they fail to understand the related lower-order concepts. This dependency is greater in mathematics than in other subjects. For example, students who do not understand arithmetic will have problem learning algebra because algebra is an abstraction and generalisation of arithmetic. Mathematics curricula are cumulative in nature; if one fails to understand one operation, one is unable to learn anything taught beyond that operation (Lazarus, 1975).

This cumulative and hierarchical nature of mathematics knowledge can create learning problems to students who lack self-discipline and have bad work habits. Various topics in mathematics are arranged and taught in a proper sequential and hierarchical order. Topics, which are prerequisites, are taught first. Each particular topic is broken into subtopics, or sections, which are also hierarchical in nature. Failing to understand one section of the topic will lead to difficulty in learning other sections that follow. To succeed in this highly cumulative and hierarchical subject, students need to have good behavioural characteristics.

Students who are weak in mathematics usually have these bad behavioural characteristics:

(1) Procrastination: They like to delay or postpone doing their schoolwork. As a result, the amount of schoolwork gets accumulated so much that they are not able to get them all done at all.

(2) They do not finish mathematics exercises and homework given by the teacher on time. When a new lesson begins, these students are still struggling to finish work on the earlier sections. They are always behind the class in doing their work.

(3) They do not follow the lessons properly so as to be always at pace with the teacher. Once left behind, they may find it hard to catch up and understand by reading the text-book on their own. Mathematics is not like most other subjects which they can learn by reading on their own. Mathematics is not easily comprehensible without further explanation and elaboration by the teacher.

(4) They are very passive in the classroom. They do not ask the teacher when they are not able to do their exercises, or when they do not understand the lesson. They need to ask promptly when they cannot understand what has been taught because failure to understand one section of the topic will lead to difficulty in understanding other sections that follow.

In learning mathematics, students need to acquire procedural skills for solving mathematics problems and, more important, to understand the concepts and principles which are related to the skills. Solving mathematics problems requires high-level computational skills and mental processes (McLeod, 1993). Students are usually required to solve a lot of problems and do many repetitive exercises. To solve problems successfully, students need to understand the underlying concepts and principles, and then, do the computational work correctly. To succeed in this type of learning activity, students need to have good personal characteristics. They need to be patient, calm and controlled, diligent and careful in doing their mathematics exercises.

Skemp (1986) was very much against rote learning or learning through memorising. According to Skemp (1986), as mathematics becomes more advanced and complex, the number of different routines to be memorised imposes an impossible burden on the memory. Furthermore, the routines learned by rote cannot be adapted by the students to solve other problems. They memorise the routines without understanding the concepts and principles behind them.

According to constructivist framework of learning, students should be encouraged to formulate ideas, explore patterns, and seek solutions, and not to practise repetitive exercises and memorise procedures and formulas (Fennema, Franke, Carpenter, & Carey, 1993). Mathematics is viewed as a subject of ideas and mental processes. In problem solving, students must acquire a body of conceptual and procedural knowledge in mathematics to support an array of problem-solving strategies (Owen & Super, 1993). Students need to know how to understand and represent problems in mathematical terms (Mayer & Hegarty, 1996).

According to constructivist approach, the stress must be in helping students make sense of mathematics. To understand mathematics, students must take an active role in learning. They cannot be passive and quite in classroom. They need to ask questions, and engage in discussions with their peers. They must be reflective and not impulsive in their thoughts and behaviours. They need to be emotionally stable. Their thoughts and behaviours are not dictated by emotion, but instead by reasoning in a logical and rational manner. Reasoning and logical thinking are essential in understanding mathematics.

2.5 Cognitive Readiness

In the past three decades, researches in the field of cognitive psychology have given us new knowledge and understanding of cognitive growth that develops in stages from birth until adulthood (Case, 1992). Previously, the general view was that intelligence was determined before birth. We have to accept these inborn differences, and provide different educational experiences according to the child's learning ability. However, through better understanding of cognitive growth, this view has changed. By understanding how and when cognitive systems develop, we can avoid teaching children something before they are ready to learn it. We should provide children with learning experiences according to their level of cognitive development.

Arnold Gesell (1940), who established the Institute of Child Development at Yale University during the 1930s, was the first to propose the idea that cognitive growth and development occurs in stages or sequential levels. Children's cognitive structure goes through periods of major reorganisation. This is followed by periods of integration during which a new stage is reached and the changes are assimilated.

Jean Piaget (1896 – 1980), a native of Switzerland, has been the major theorist in the field of cognitive development. Originally a biologist, Piaget's interest in epistemology brought him into the world of psychology. At J. J. Rousseau Institute of Child Study in Geneva, Piaget spent his time doing research on how thinking develops in children. Using direct, careful, and systematic observation of children (including his own, Jacqueline, Laurent, and Lucienne), Piaget began to develop his theory of cognitive development.

2.5.1 Piaget's Theory of Cognitive Development

According to Piaget (1952, 1959), people have an innate need to understand the objects, events, and ideas that exist around them. Equilibration is the act of searching for meaning, understanding, and order in what they see in the real world. Equilibration is the process of making sense of what they see based on what they already knew. It is a dynamic process that attempts to reduce dissonance. Learners will strive for equilibrium, which is a state of cognitive balance. If they cannot explain what they see on the basis of their present knowledge or understanding, disequilibrium occurs, which will motivate them to search for meaning and new understanding. Disequilibrium is an energising force in cognitive development.

In Piagetian theory, disequilibrium is the disruption of cognitive processes that occurs when children have experiences that they cannot explain or understand in terms of their existing knowledge or cognitive structures. Piaget believed that the primary stimulus to cognitive development comes from the children's own attempts to make sense of new experiences that they encounter.

Piaget proposed that children are always busy constructing and organising schemata. Schemata (singular: schema) is a Piagetian term which refers to the elaborate cognitive structures, or networks, made up of ideas and concepts. that are used by the children to interpret and understand what they see around them. and to guide their behaviour. These schemata, which are constructed and organised in the children's minds, will influence how they see the world and interact with it.

Existing schemata are combined to form new and more complex ones. This process is called organisation. Organisation of existing schemata is an important intellectual function because it results in the formation of higher-order and more complex cognitive structure in an individual.

As children grow and develop, they encounter new objects. new information. and new experiences. which require them to think and act in new ways. They must be able to adapt to the new demands. According to Piaget. adaptation is a central drive of humans in order to survive. To adapt to the new demands. children undergo the process of assimilation and accommodation.

Piaget refers assimilation to the process of expanding or enriching the existing schemata with the new information or experience. They try to make sense of what is new by relating it to what is already familiar to them. The existing schemata do not change. Accommodation refers to the process of altering or modifying the existing schemata in order to make sense of the new information or experience. What is already known is modified in order to fit the new information or experience. Accommodation results in the formation of new schemata.

Cognitive development is a life-long process. It evolves through the creation of schemata and organisation of existing schemata into more complex schemata. These schemata may be enriched by assimilating new cognitively compatible informations or experiences. Through the process of accommodation, new schemata may be created by altering the existing schemata in order to account for new informations or experiences.

In Piagetian theory, learning is the process where learners try to equilibrate between the new and the old information. They use what they already know to understand the new concepts, ideas or objects that they are required to learn. New learning occurs when they succeed and reach equilibrium in the equilibration process. The phases of learning can be described as follows:

1. When a teacher introduces a new concept or idea, an awareness of discrepancy or mental disturbance occurs in the students when they try to understand or make sense the new concept or idea.

2. A feeling of puzzlement, curiosity and uneasiness will arise in the students. The new information may not fit their prior understanding.

3. The students need to go through a period of reflection, where they try to fit the new information into their existing schemata. The process of assimilation or accommodation will take place.

4. After sufficient time, the students are able to understand the new concept or idea, and it becomes "old" information. New learning has occurred.

5. When another new concept or idea is taught to the students, the process continues with the same phases as above.

For meaningful learning to occur, students must take an active role in the learning process as described above. According to Piaget (1970), intelligence is not fixed at birth, but is a function of appropriate activity during any particular stage of cognitive development. In order for meaningful learning to occur, students must engage in appropriate activities, and not just merely sit and listen. Piaget calls for active schools because according to Piaget (1970), intelligence = activity. Activity produces cognitive growth.

Piaget (1970) suggested that teachers should present the subject to be taught in forms which can be assimilated by the students of different ages, in accord with their mental structures. If students are required to learn something, which is beyond their present mental structures, their existing schemata may not be able to assimilate or accommodate the new information. In the equilibration process, they will not be able to achieve equilibrium. New learning does not place.

Difficulty in comprehending the new information can lead to anxiety and frustration, and this may lead students to learn without understanding, which is learning by rote memorisation.

Piaget (1932/1965, 1950, 1952, 1959) devised a theory of cognitive development. Piaget proposed that cognitive structure develops in an orderly way through stages that build upon one another. He proposed that there are three stages of cognitive development.

2.5.2 Stage 1: Sensorimotor Experience (Age: Birth to two years)

Cognitive activity during this stage is based primarily on immediate experience through the senses. Sensorimotor children use their sensory and motor capacities to make sense of the world. They look, touch, suck, hit, shake and grasp any objects that they encounter. The major activity is the physical interactions with the environment. Children at this stage like to look at and follow objects with their eyes. Initially, these children do not represent objects mentally; for them objects, which are out of sight, are out of their minds. Later in the period, by age one, children are able to acquire object permanence, which is the ability to understand that when an object disappears from view, it still exists even though they cannot see it.

The development of object permanence is likened to the first stage of recognition, and the beginning of an elementary memory. Since object permanence develops in this stage, we know that sensorimotor children are also capable of some representational thought. They begin to develop the ability to represent objects in their memory. Towards the end of this period, children are able to manipulate images in their heads, as shown by their ability to imitate. The ability to imitate is an important skill that forms the basis for later observational learning.

2.5.3 Stage 2: Intuitive or Pre-operational Thought (Age: Two to seven years)

Pre-operational period is the stage when rapid and dramatic growth occurs in the cognitive structure of children. The emergence of symbolic thought occurs during this period. Pre-operational children can use symbols to represent objects. During this period, we see rapid progress in language development The children's ability to understand and use words, and their vocabulary development increase dramatically.

Children at this stage can perform simple mental operations such as classifying animals as dogs or cats. They begin to develop an understanding of many concrete concepts. They can form ideas of objects and identify them with names such as cat, horse, car and tree. However, they are still unable to understand concepts which are abstract in nature.

Mental structures of pre-operational children are largely intuitive and highly imaginative. Their mode of thinking seems to be illogical. The characteristics of pre-operational children are:

1. Egocentrism, which is the inability to interpret an event from someone else's point of view. They see things only from their own point of view.

2. Centration, which is the tendency to focus on one perceptual aspect of an object or event to the exclusion of all others. For example: Show a five-year-old child two rows of coins, with each row having the number of coins. The child can tell that the rows have the same number of coins. Then, lengthen one row by increasing the spaces between the coins without changing the number of coins. When asked, the child will say that the lengthened row has more coins. This is because the child centres on the length of the row, rather than on the number of coins in the row.

3. Unable to transform. Transformation is the ability to mentally record the process of changing from one state to another. In the coin example above, because the child is unable to transform, the lengthened row is considered to have more coins.

4. Unable to reverse. Reversibility is the ability to mentally trace a line of reasoning back its beginning. In the coin example above, the child is unable to reverse the lengthening process to determine that the two rows still have the same number of coins.

5. Unable to conserve. Conservation is the idea that the amount of substance remains the same regardless of its shape or the number of pieces into which it is divided. For example: Give a pre-operational child two balls of clay of same size, and each having the same amount of clay. Then, change the shape of one ball into a flat shape. When asked, the pre-operational child will say that the two different shapes of clay do not have the same amount of clay.

6. Unable to reason systematically. Pre-operational children are not able to reason systematically, either in deductive or inductive way. They cannot reason from the particular to the general, or vice versa. Instead, they reason from particular to particular, which Piaget calls transductive reasoning. For example, when we ask a pre-operational child why it is dark at night, he may give answers such as because that is when we go to sleep. During this period, children's thinking can be described as pre-logical. They do not recognise cause and effect links between events, or they misunderstand them (Piaget & Inhelder, 1969).

2.5.4 Stage 3 : Concrete Operations (Age: Seven to eleven years)

In the concrete operations stage, children go through another major reorganisation of mental structure. They are able to think in logical way. Concrete operational children are very literal-minded. Children at this stage use explicitness and literalness as a basis of their interactions with others, and in their jokes. They can understand rules and their functional values. However, their understanding of rules is literal: Rules are given laws that cannot be changed. Adults, on the other hand, understand rules as a system of regulations that can be changed and replaced when necessary.

During this period, children can learn and understand concepts which are concrete in nature. Their mode of thinking is concrete and they do not have the mental ability to grasp abstractions. They translate abstractions into concrete and highly specific terms. Concrete operational stage is characterised by the ability to think logically about concrete objects. Children begin to develop reversible, organised mental operations that allow them to conserve, classify, and take alternative views (Flavell, Miller & Muller, 1993).

According to Piaget, during this period, children acquire schemata to understand arithmetic, think in symbols, and classify objects into categories. They can perform mental operations based on concrete experiences, and are able to modify their views in order to reach a logical conclusion. They can arrange objects in order; arrange numbers in proper sequence; group objects by colour, size, or shape; and understand rules for mathematics and appropriate behaviour in classroom. This is the time when children are ready for formal education. In many countries, we see that the beginning of the concrete operational stage (age seven) is the time when children begin to go to school for formal education.

During the concrete operational stage, children's cognitive structure becomes more complex and organised which enables them to perform a variety of logical operations. The major cognitive characteristics of concrete operational children are:

1. Decentration: Concrete operational children are able to consider several important features of an object or a task rather than focus their thinking on one particular aspect or the perceptually more obvious one. For example, pour an equal volume of water into two glasses of different height and width. Children at this stage understand that the volume of water in both glasses is the same because they are able to consider both the aspect of height and width of the two glasses. By focussing on both aspects, they know that in the taller glass, the water is higher because its width is smaller. Pre-operational children, on the other hand, may focus only on height, and will say that the taller and thinner glass has more water in it.

2. Reversibility: Concrete operational children can reverse their thinking and perform mentally a series of steps backwards in order to return to its original condition. For example, they understand that addition and subtraction are reversible operations.

3. Conservation: Concrete operational children understand that objects remain the same regardless of changes in shape or arrangement. For example, show these children two clay balls of equal size. Then change the shape of one of the balls, such as by pressing it into the form of a pancake. Then ask these children which one is bigger. They will say that they are of equal size. As another example, show these children two pieces of iron bar of equal length. Then bend one bar into an arc shape. Then ask these children which iron bar is longer. They will say that both are still equal in length.

4. Hierarchical classification: Concrete operational children can group objects into classes and subclasses. For example, when these children cards of different colours, shapes and pictures, they can group these cards according to colour, shape or picture.

5. Seriation: Concrete operational children can arrange objects by height, weight, or age in increasing or decreasing order. They can arrange objects in

order from lightest to heaviest, and then rearrange them from smallest to biggest.

6. Transitive inference: Concrete operational children can mentally compare objects and the make inferences. If object A is bigger than object B, and object B is bigger than object C, then they can infer that object A is bigger than object C without directly comparing object A and object C.

Even though concrete operational children have acquired complex mental operations, they are only able to perform these mental operations with concrete objects or under concrete situations. They cannot perform these mental operations with things that they cannot see or touch. If a learning task is presented in a verbal form without showing concrete objects, children at this stage will face difficulty in performing the task successfully.

Concrete operational children are not yet good in deductive logic but are adept at inductive reasoning (Tomlinson-Keasy, Eisert, Kalle, Hardy-Brown, and Keasey, 1978). These children can think inductively by reasoning from concrete examples to general rules. They are not yet good at deductive thinking because they cannot understand a general rule without first seeing concrete examples. Their logic only works when they operate with concrete objects or situations, but not with abstract situations. Their mental operations are not yet ready for abstract concepts and ideas.

2.5.5 Stage 4: Formal Operational (Age: 12 years to adult)

According to Piaget, formal operational is the final stage of cognitive development. During this stage, children begin to develop mental abilities to think in abstract terms. They are now ready for the realm of abstract concepts and ideas. They have progressed from being able to think logically only about concrete objects or situations into being able to think logically about abstract and hypothetical situations. For example, without having to refer to concrete objects, formal operational learners can think abstractly and make generalisation that if x is greater than y, and y is greater than z, then x is greater than z. They can express this relationship symbolically:

If $x > y$, and $y > z$, then $x > z$.

The ability to use symbols to represent objects or abstract ideas is a characteristic of formal operational thinking. The ability to think in abstract and symbolic terms enables formal operational learners to engage in learning tasks which require high order thinking skills. During this stage, learners are ready to mathematical concepts and ideas which are abstract and symbolic in nature.

Formal operational learners are able to think systematically. By thinking systematically, they can plan strategies to solve abstract problems. During the earlier concrete operational stage, learners can reason only from concrete situations, and their ability to reason is limited to two-factor situations. Formal operational learners, in contrast, can deal logically with abstract and multiple-factor situations. They can consider multiple factors, deduce multiple possibilities, and systematically eliminate or exclude those which are not relevant.

Another characteristic of formal operational thinking is hypothetical-deductive reasoning. Learners at this stage are able to think hypothetically and deductively. They can think of possibilities, pose hypotheses and draw conclusions after making observations and reasoning in their thoughts. They can think logically about abstract and hypothetical ideas. They are able to ask "if-then" questions. They can now think and debate on concepts such as justice and morality. They can think through complex if-then relationships and form their own conclusions. They can solve mathematical problems using a set of defined assumptions and procedures. Cognitively, they are ready for secondary school curricula, which are filled with learning tasks and experiences requiring formal operational thought.

According to Inhelder and Piaget (1958), formal operational learners are able to perform combinatorial operations because they can analyse relationships in multiple-factor situations. For example, given four characteristics, such as white and red and tulips and roses, formal operational learners can generate 16 possible combinations such as white tulips and white roses, red roses and white tulips. and so on. Concrete operational learners, on the other hand. can generate only four combinations: red roses, red tulips, white roses and white tulips.

In the colourless liquids experiment (Inhelder & Piaget. 1958). students are given four beakers containing colourless liquids, and a substance to be added to the combinations of the four liquids so that the liquid in become yellow in colour. Concrete operational students proceeded to test combinations. two by two. which resulted in omissions and failures of getting the correct combination. Formal operational students, however, were able to think and figure out all the possible combinations, and then proceeded to test these possible combinations. These students succeeded in the experiment because they were able to think systematically, conceptualise all possible combinations. make hypotheses and then proceeded in testing to determine its actual outcome.

The process, which enables learners to progress from relatively impoverished to richer cognitive structures, is reflective abstraction (Piaget. 1980). Reflective abstraction is the process of projecting something from a lower level to a higher level of mental operation. and reconstructing of cognitive structure. Reflective abstraction involves the learner's thought processes. At the stage of formal operations. thought processes are independent of any reference to concrete objects or situations. Ideas can be tried out in the mind. Through a process of imagination and internal dialogue, which is talking to oneself, formal operational learners are able to reach new insights without actually referring to concrete reality.

Formal operational thoughts are no longer limited to here and now as during the concrete stage, but are extended by considering all possibilities. Through systematic thinking and planned hypothesis testing, they become more efficient in problem solving. They are able to expand their thoughts beyond concrete objects and situations to ideas and abstract concepts. Their thoughts are not just focused on their own perspective, but are enlarged to include the perspectives of others.

Formal operation is the period of mature thinking. The characteristics of formal operational thinking include: (Flavell, Miller, & Muller, 1993; Keating, 1979, 1990)

(i) Abstract thinking, which is the ability to think about concepts and ideas, and to think about possibilities beyond concrete reality.

(ii) Propositional thinking, which is the ability to think logically about relationships among ideas, concepts, propositions, and operations.

(iii) Combinatorial thinking, which is the ability to consider and generate different possible combinations of ideas.

(iv) Hypothetical-deductive thinking, which is the ability to think scientifically, to identify and define variables, conduct tests and experiments, and make appropriate hypotheses.

(v) Problem solving, which is the ability to think systematically, define problems, select a suitable strategy, and revise options if necessary.

(vi) Meta-cognition, which is the ability to think about their own thinking and thought processes.

(vii) The ability to be self-reflective about their own thoughts and on issues such as morality, existence and self-identity.

Recent studies in cognitive development have found results which are consistent with the Piaget's theory. Cognitive development is continuous and not discrete. Children develop gradually, and experiences in one stage form the foundation for movement to the next stage (Berk,1997). All children pass through each stage before progressing into the next one. No children skip any stage. The ages attached to the stages are approximate. The rate at which children progress through the stages differs, depend on maturation rates and culture (Papalia & Wendkos-Olds, 1996).

According to Piaget's theory, students in secondary schools and colleges should be formal thinkers, but research indicates that this is not always true. Keating

(1979) found that 40 to 60 percent of college students failed to answer a problem which requires formal thought. De Lisi and Straudt (1980) found that college students were unlikely to think formally in areas outside their majors. It appears that formal operational thought is situation specific. Students are able to demonstrate formal thinking only in areas in which they are familiar or have achieved considerable mastery. For example, physics majors are able to demonstrate formal thinking when dealing with physics problems and not problems outside their field of study.

In Piaget's theory, formal operation is the final stage and the apex of cognitive development. However, Arlin (1975, 1977) disagrees and proposes that there is another stage after that, which is late formal operations. Piaget's focus on logical reasoning may have excluded thoughts in other areas such as wisdom and creativity. Wisdom and creativity are the essence of great thinkers and scientists. Arlin believes that great thinkers and scientists like Einstein, Freud and Piaget operate in a higher cognitive dimension than just problem solving, which enables them re-conceptualise existing knowledge and reformulate it to come up something new and unique. She calls this stage as the problem-finding stage. This final and advanced stage is characterised by the ability to develop new solutions, devise programs on broadened vision, and formulate productive questions that enable individuals to expand knowledge base and gain fresh insights.

2.6 Learning Strategies

Students face the task of having to learn and understand a large variety of knowledge from many different subjects that they have to take in school. To acquire these varieties of knowledge and information, they have to study them fully, understand and find ways to remember them so that these knowledge can recalled and used to answer questions during examinations. There are qualitatively different ways of how students think about and carry out the learning process which produce qualitatively different learning outcomes (Biggs, 1979; Marton & Saljo, 1976). Learning strategy refers to the systematic planning and approach that the students use in their efforts to acquire and process new knowledge and information. Learning strategies, which are often used, are rote learning, instrumental learning, surface and deep processing approach, and meaningful learning approach. The learning strategy that students choose in carrying out their learning tasks can range from the simple and raw approach of rote memorising to a more sophisticated and intelligent approach of meaningful learning.

2.6.1 Rote Learning

Rote learning is memorising without understanding. The strategy of learners who use this approach is to memorise all the information. facts. formulas. and procedures that they read from text-books and that are taught by their teachers. Their emphasis is on memorising without giving much importance to meaning and understanding. Rote learning involves doing a lot of repetition work and drilling exercises. Rote learning strategists believe that repetition and drilling exercises will create a deep impression in their minds and thus enhance their memory. Learning through rote memorisation is characterised by lack of activity. questioning and discussions. Students sit passively at their desks. listen attentively to their teachers, and then do a lot of exercises. Lack of questioning and discussions show that these students do not care much for meaning and understanding of the subject matter.

It is now generally acknowledged that rote memorisation as an approach to learning has a lot of inadequacies, and will not lead to cognitive growth. Without understanding. the knowledge learned is easily lost and forgotten. Knowledge is retained better if it is understood and can be stored as part of a network of knowledge in the learner's cognitive structure. Knowledge acquired purely by rote can only be stored in long-term memory separate from and unconnected with other knowledge. This makes both retention and recall difficult. Skemp (1986) found that learners who learned in a systematic and meaningful way were able to learn better. retain better. and were able to recall the material much more when compared with rote learners.

Educational psychologists are very critical of rote memorisation as an approach to learning. Vygotsky, a Russian educational psychologist in the 1920s. regarded memorisation as "fossilisation", or a dead end. According to Vygotsky. people must be taught not only how to read, but more importantly, how to understand what they were reading (Blanck, 1990). Rote learning does not promote intellectual growth. In learning mathematics, many students use rote learning because they are not able to find meaning or understand many of the abstract concepts and ideas of mathematical knowledge.

Many students believe that mathematics consists primarily of rules and procedures to be memorised, there is only one right way to solve a problem. and the goal in doing mathematics is to get the right answer (Lampert. 1990: Schoenfeld.1992). Society as a whole and teachers in particular believe in the same away about mathematics (De Corte. Greer. & Verschaffel. 1996). Teachers. who hold these beliefs and interacts with students. will transmit these beliefs to their students. As a result of these negative beliefs about mathematics. students' approach towards learning mathematics is to rote memorise all the rules. formulas and procedures. and use them to solve problems in order to get the right answer. Because there are so many different rules and procedures involving many different topics, students will be under tremendous stress and anxiety to memorise all of them.

The amount of learning material which a bright child can memorise is remarkable, and the appearance of learning mathematics may be maintained until a level is reached at which only true conceptual learning is adequate to the situation (Skemp, 1986). Students need to understand the concepts and ideas which underlie these rules and procedures and retain them in memory as an integrated network of knowledge structure. Rote learning, with so much rules and procedures to memorise, will lead to anxiety, hatred and fear towards mathematics, and ultimately, will lead to failure in learning mathematics. Rote learning does not produce transfer of learning. As a result, rote learners are not able to solve unfamiliar or non-routine problems. In tests, they fail to answer the questions because they cannot remember correctly the facts, rules and procedures, which is characteristic of their rote learning strategy.

The National Council of Teachers of Mathematics (1989), in their publication of the *Curriculum and Evaluation Standards for School Mathematics* gave recommendations and proposals regarding learning of mathematics at the school and classroom levels. These recommendations and proposals are commonly called as the *NCTM Standards*.

The *NCTM Standards* gave the following assertions with regard to how learning of mathematics should be conducted at the school level:

1. Mathematics is a problem-solving activity, not the application of rules and procedures.

2. Mathematics involves reasoning more than memorisation.

3. Studying mathematics should make sense.

4. Mathematics is communication.

5. Mathematics should relate to the real world.

6. Learning through memorising of facts, rules and procedures should not be emphasised.

7. Doing repetitive exercises, routine problems and skills without context should not be encouraged.

8. Teachers should avoid teaching by telling.

The way mathematics is taught by most teachers is very much against the *NCTM Standards*. The most common practice of teaching mathematics in schools is characterised by the following steps:

1. The teacher transmits knowledge to the students through telling. The teacher tells and explains to the students all the facts, definitions, rules and procedures about the material to be learned. Most of the times, the students sit passively and listen attentively to the teacher.

2. The teacher proceeds by giving a few examples of how to use these rules and procedures in solving problems.

3. Then, the teacher gives exercises to be done by the students. The remaining of the class time is used by the students to do the exercises. Usually, there is not much activity and discussion. The students sit passively at their desks doing the exercises given by the teacher. At the end of class, the teacher gives more exercises as homework.

4. At the end of a topic, the teacher usually gives a test to evaluate the students' understanding of the topic.

The students, under pressure to perform and impress their teacher in the test, will resort to rote memorising the facts, rules and procedures in the topic. Before they are able to digest and make sense of the material that has been taught, the teacher is already progressing to a new topic. Under this kind of learning scenario, students will obviously resort to rote memorising as their learning strategy in order to cope with the demands and tasks of learning. When learning is very examination-centred, rote learning is the dominant strategy. In examination classes, we may find teachers asking their students to do a lot of repetitive and drill exercises in order to score high grades. Kimball (1989) asserts that female students take a rote learning approach to mathematics, based on the routine use of rules and algorithms learned in class. Male students, on the other hand, have a more autonomous approach towards learning mathematics, which involves generalising mathematics knowledge to new or unfamiliar problems. Males perform better on problems which require real-life applications and higher-level cognitive processing.

Scott-Hodgetts (1986, 1987) hypothesised that female students are often proficient at memorising rules and algorithms and at performing straightforward computations. Proficiency in the rote memorisation of rules and algorithms may result in short-term success (high test grades). Sitting down quietly and passively at their desks doing routine and repetitive exercises seems to be more habitual of female than male students. This is one of the reasons why we see female students usually outperform male students in tests and examinations. However, emphasis on rote learning sends an incorrect message to students concerning the nature of mathematics, and the skills that are important. Proficiency in rote memorisation, which results in short-term success (high test scores), may be achieved at the expense of the more important goals of increasing conceptual understanding and developing confidence and competence in mathematical problem-solving and reasoning skills.

2.6.2 Instrumental Learning

Learning mathematics is very much concerned with learning algorithms. An algorithm is a step-by-step procedure for doing a particular mathematical operation. These steps must be carried out in correct sequence, according to its flowchart, in order to get the right answer. In mathematics, from primary, secondary and college level, there are all kinds of algorithms which must be learned by students. Some examples of algorithms are:

- Long multiplication and division.
- Adding, subtracting, multiplying and dividing fractions.
- Multiplying matrices.
- Changing denary numbers to binary.
- Solving linear and quadratic functions.
- Finding minimum or maximum point of a curve by differentiation.
- Finding area or volume by integration.

Instrumental learning refers to the approach which emphasises learning of algorithms. Instrumental learners usually learn the step-by-step procedures of the algorithm by memorising. Learning is instrumental by nature – to be able to use the algorithm correctly in their effort to solve and get the right answer to a problem. The learners' main concern is the "how" but not the "why" aspect of learning. This approach will lead to instrumental understanding, but not relational understanding (Skemp, 1976). Instrumental learners are able to use algorithms, but they do not understand the ideas or concepts behind these algorithms.

According to Skemp(1976), students have achieved instrumental understanding if they understand what to do to get the right answer, but they have not necessarily achieved relational understanding. For example, many students are able to carry out the step-by-step procedure of the algorithm for changing denary numbers to binary. Given a denary number, divide it by 2 and record the quotient and the remainder (either 0 or 1). Continue dividing the quotient by 2 until the quotient is 0. The remainders, written in reverse order, are the required binary number. Students can easily carry out the above steps, but it is doubtful that they understand why the algorithm works. Without relational understanding, these algorithms are meaningless to the students.

Scott-Hodgetts (1986) claims that female students understanding of mathematical concepts and operations tends to be instrumental whereas that of males tends to be relational. Instrumental learners understand rules and algorithms without reasons. These learners will have difficulty to generalise knowledge to other instances or to see relationships between various topics.

Brown and Wheatley (1989) asserted that instrumental understanding does not require the construction, representation, or transformation of any images, as does relational understanding. Rules and algorithms should be used thoughtfully so as to develop and promote relational understanding. Too much instrumental understanding in learning mathematics is like building a tower on insecure foundations. Such a tower will eventually collapse. Instrumental learners usually get high scores in class tests because they are proficient in the "how" aspect of doing mathematics. However, when it comes to performing high-level cognitive tasks and solving unfamiliar problems, instrumental learners usually crumble and fail.

2.6.3 Surface and Deep Processing Strategy

Marton and Saljo (1976) identified two contrasting approaches to the processing of information in learning situations. They called these two approaches as surface and deep processing. In surface processing approach, the student focuses solely on the learning material itself, and regards the material as what needs to be learned, without attempting to understand and link it to a larger conceptual framework. Students, who use surface processing approach, are usually extrinsically motivated. These students are motivated to fulfil the demands placed on them by others. They are very much examination oriented. Their goal in learning is to get high grades in examinations. Meaning and understanding becomes secondary to them. These students will study when examinations are near.

Surface processing approach has often been equated with rote learning (Marton. Watkins, and Tang, 1997). Learning is regarded as a passive transmission of knowledge to the brain of the learner. Students usually play the passive role – sit quietly, listen, read and memorise. Characteristics of students who use surface processing approach are lack of interest in the subject, passive learning, unrelated memorising, learning with intention to reproduce for examination, and fear of failure.

According to Marton and Saljo (1976), in deep processing approach, students regard the learning material as a means in seeking understanding of the underlying meaning of the learning material. The students seek to understand beyond the signs and words of the material they are reading or listening to. Deep understanding and meaning are the primary goal. Students, who use deep processing approach, are usually intrinsically motivated. They love knowledge. and learn for the sake of learning, with less concern about others evaluations of their performance. Scoring high grades in examinations is not their primary goal. Learning is viewed as constructing meaning in the process of understanding reality.

Success in examinations can be achieved through either approach, but in situations which require deep understanding rather than just reproducing facts and information, students who use deep approach will excel. Characteristics of students who use deep processing approach are high interest in the subject matter, orientation towards mastery of knowledge, mindfulness active learning with intention to understand, and ability to relate ideas and communicate ideas to others. These students are more confidence of their learning ability. They are motivated to study not by fear of failure in examinations, but by their need to perform their best and achieve excellence in life.

Wan Zah (1992) found that surface processing approach is the dominant learning strategy among second year university students. The students' intention in performing the learning task determines whether they choose surface or deep processing approach. Students, whose intention is to seek meaning and understanding of the learning material, will choose deep processing approach. Whereas students, whose intention is just to get good grades and to fulfil course requirements, will choose surface processing.

Wan Zah (1992) proposed that teachers should encourage students to use deep processing approach in their learning strategy. This is because deep processing approach, which emphasises meaning and understanding, will result in the love for knowledge, and will enable students to think creatively and critically. Surface processing approach, on the other hand, emphasises memorisation of facts and information so that they can be recalled and reproduced during examination. When students learn without meaning and understanding, they will not be able to appreciate knowledge and feel the joy of learning.

2.6.4 Meaningful Learning

In meaningful learning strategy, students will attempt to seek understanding and meaning so that the material they are learning makes sense to them. According to Ausubel (1968), meaningful learning is a process in which students actively construct their own learning outcomes. In his theory of meaningful learning, Ausubel (1968) proposed that meaningful learning occurs when students relate new material non-arbitrarily and substantively to their cognitive structure. For this to happen, the learning material must have the potential of making sense to the students, and the students must possess and use relevant cognitive structure during learning.

Rote and meaningfully learned materials are represented and organised differently in the students' cognitive structure (Ausubel, 1968). Meaningful learning promotes good transfer of knowledge and enhances problem-solving ability. In meaningful learning, students take an active role in learning. In order to understand what they are learning, students must actively construct meaning

(Wittrock, 1990). The meaningful learner is an active processor of information who is trying to make sense out of the presented material (Mayer, 1992)

In meaningful learning, students are not passive recipient of knowledge, but they engage in an active role of constructing and expanding their cognitive structures. According to Mayer (1987), there are three cognitive processes involved in the process of meaningful learning:

- Reception and selection of information.

  This requires students to concentrate and to attend to the incoming information (through reading the text or listening to lecture) so that the information gets into their sensory memory. During this process, students select relevant information and transfer that information from a rapidly decaying sensory memory to active consciousness in short-term memory.

- Organisation of information:

  When the selected information has been transferred to short-term memory, the students engage in the cognitive process of organising the information. Organisation, which takes place in short-term memory, is the cognitive process of building internal connections among the selected pieces of information so that they become a coherent and integrated whole.

- Integration of information:

  Integration is the cognitive process of building external connections between the new incoming information and relevant existing knowledge. The new information is integrated with other familiar knowledge structures which have already existed in long-term memory. For meaningful learning to occur, students must possess prerequisite or prior knowledge of the new incoming information. Without relevant prior knowledge, the new information will not be learned meaningfully because the students are not yet cognitively ready for it.

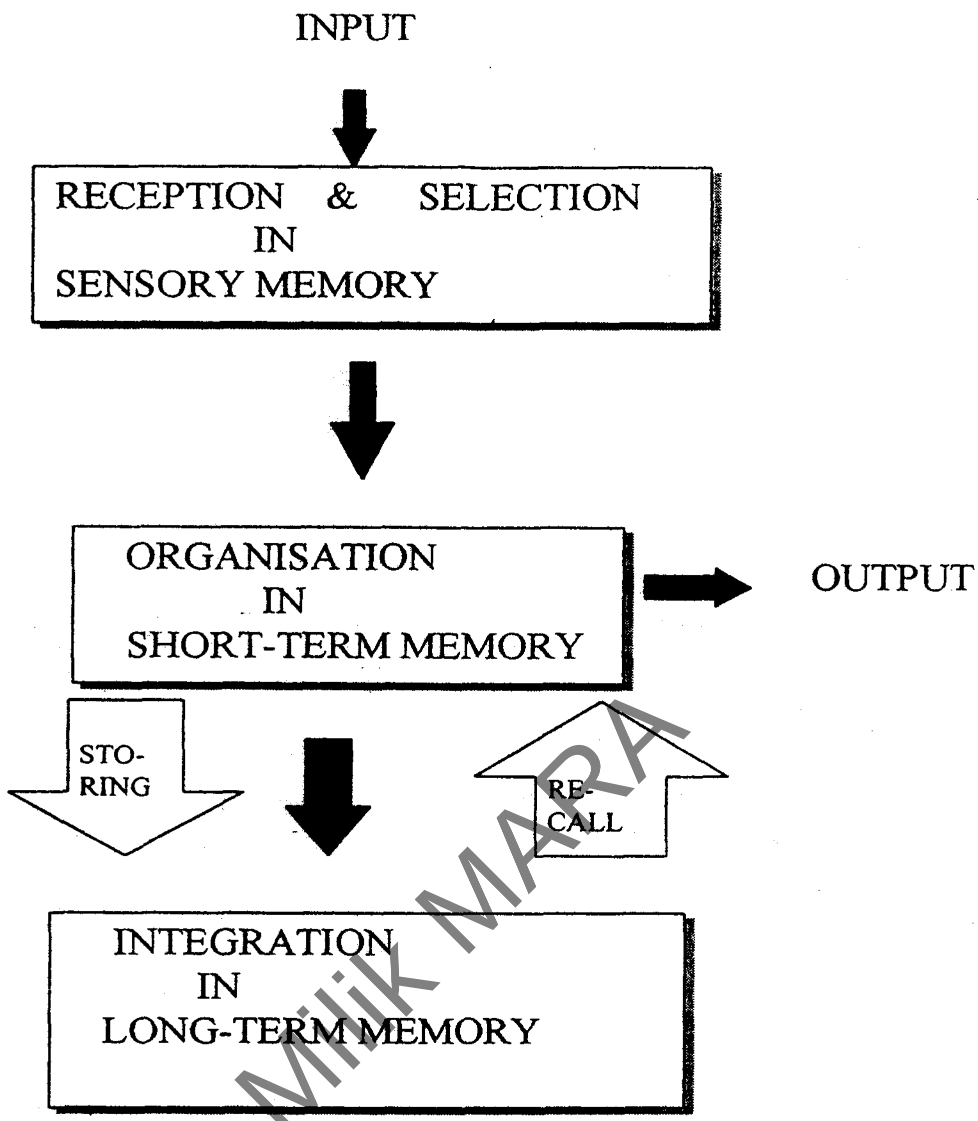


FIGURE 2.3 Flowchart of Meaningful Learning Process

Active learning is the main characteristic of meaningful learning. Students are not passive absorbers but active constructors of knowledge. In the construction of knowledge, they select relevant information, build internal connections, and build external connections. Wittrock (1990) found that students, who construct and generate internal and external relations in what they are learning, were able to gain more comprehension and transfer of knowledge. To create active learning situations, teachers should use teaching strategy which allows their students to engage in activity and discussions. Teachers should create appropriate questions and problems so as to stimulate thinking or mental activity in the students. The purpose of active learning is to encourage students to actively engage the cognitive processes of selecting, organising, and integrating during learning.

Meaningfulness occurs when learners are able to form connections or associations between an idea and other ideas in the long-term memory (Gagne,Yekovich, & Yekovich, 1993). Organising and attaching new information to old is critical in meaningful learning. Organisation refers to the process of clustering related items of content into categories or patterns in the cognitive structure. To achieve meaningful learning, learners have to be cognitively active.

According to Vygotsky, meaningful learning occurs when students engage themselves in problem-solving activities that are just beyond their current level of mental functioning, which he referred to as "zone of proximal development" (Blanck, 1990). Teachers should give their students problems which are slightly beyond their present competence. There should be active learning through meaningful activities. Students should not be asked to memorise but rather to engage in problem-solving activities and then try to draw out reflective meaning through discussion.

The view that learners are active constructors of knowledge and not passive recipients or absorbers of knowledge has been the main idea of constructivism. Constructivists believe that understanding is gained by an active process of construction rather than by passive assimilation of information, or rote memorisation (Confrey, 1990). They have been strongly influenced by Piaget's idea that conceptual abilities grow out of intellectual activity rather than by absorption of information (Steffe, Cobb, & von Glasersfeld, 1988). Meaningful learning has been the emphasis of constructivism.

Greeno (1991) criticised the learning situation where in most schools, what students mostly do is listen, watch, and mimic things that the teacher and textbook tell and show them. Learning is an active and constructive process. Students should be encouraged to actively construct their knowledge and skills through interaction with the physical and social environment, and through reorganisation of their own mental structures.

Cobb (1990) also criticised the information-transmission approach of mathematics education, where students are considered isolated, and are driven to absorb a collection of pre-specified mathematical facts, rules, and procedures. Students should be equipped with the necessary knowledge, skills, beliefs, and motivation to approach new problems and learning tasks in an efficient and successful way (De Corte, 1995).

Constructivism is a view of learning which emphasises the active role of the learner in building understanding and making sense of the world. Characteristics of constructivism are (Mayer, 1996):

- Learners construct their own meaning.
- New learning depends on current understanding.
- Social interaction and discussion facilitates learning.
- Meaningful learning occurs within authentic learning tasks.

Through constructivism, students can achieve meaningfulness in learning. Students need to be cognitively active in linking new knowledge to what they already know, and in the application of knowledge to authentic situations. Interaction and discussion with teachers and other students, and relating knowledge to real experiences are tools for gaining meaningfulness. Teachers should go beyond lecturing and telling as their teaching method. Instead, they should move toward "structuring reflective discussions of the meanings and implications of content and providing opportunities for students to use the content as they engage in inquiry, problem solving, or decision making" (Good & Brophy, 1997, pp. 398 – 399).

2.7 Learning Styles

In any learning situation, learners have their own unique ways of engaging in the learning process. Learners have their own preferred ways of learning or learning styles. Lindvall and Cox (1969) found that one of the characteristics of individual differences among students is their learning styles. Learning style is combination of processes and strategies which are used consistently by a student whenever he/she engages in a learning activity (Schmeck, 1988). Keefe (1982) viewed learning style as the individual's cognitive, affective and behavioural characteristics which determine how the individual perceives, interacts and responds with the world around him.

According to Gremli (1996), learning style is the way a person processes, internalises and concentrates on new learning materials. Each person learns in a unique way. No one person learns in exactly the same way as another person. Students will learn better when they receive information in the same way as they process information. Dunn (1992) describes learning style as the way a person concentrates on, processes, internalises, and remembers new learning material. Learning styles involve the various stages in learning which include how the person takes in the information, processes that information internally, and then is able to remember and use that information.

Many researchers have conducted studies on individual differences in learning styles. Various learning styles have been identified such as reflectivity versus impulsivity, divergent versus convergent thinking style and global versus analytic. Franklin (1992) identified learners who are either global or analytic in their learning styles. Global learners are described as holistic/visual and analytic learners as verbal/analytic (Tharp, 1989). Learners can also be identified as either field-dependence or field-independence in their learning styles (Witkin, Moore, Goodenough, & Cox, 1977). Field-dependent individuals see objects in terms of large, connected patterns. Field-independent individuals, on the other hand, tend to notice the discrete and individual parts of the object.

Field-dependent learners are global or visual/holistic in their learning style. Field-independent learners, on the other hand, are verbal/analytic in their learning style. Lourdusamy (1994) found that the field-dependence/independence learning style is related to achievement in school subjects. Field-independent learners are able to think analytically, and they have shown better performance in mathematics and subjects related to mathematics (Lourdusamy, Zainal, Gajaraj, Peter Choo,& Lee Ean Kee, 1989). Threadgill (1979) and Berenson (1985) have also found that field-independent students performed significantly better then field-dependent students in mathematics. Cognitively, field-independent students are analytically oriented, and they are able see the whole object, break it into its constituent parts, and focus on details.

According to Witkin, Moore, Goodenough and Cox (1977), field-dependence/independence learning styles are stable traits of individuals, which affect the way how they learn in the classroom. Field-dependent learners perceive objects, ideas or concepts globally. They like to relate ideas or concepts to personal experience. These learners are very dependent on their teachers. They like teachers who can guide them, give demonstrations and show them how to organise their school work. They like to build strong relationship with their teachers, and seek reward from their teachers. They like to co-operate and work with others, and they are sensitive to the feelings and opinions of the people with whom they work.

Field-independent learners, on the other hand, are analytic in their learning style. When presented with objects, ideas or concepts, they are able to break into parts and focus on details of these various parts. They can focus on the facts and principles of the material which they are required to learn. These learners are not dependent on teacher. They rarely establish close relationship with teacher. They formally interact with teacher only when there are specific tasks to be done involving the teacher. They are independent learners who prefer to work alone, like to compete, and seek non-social rewards. They can organise their schoolwork by themselves.

Garger and Guild (1984) believe that field-dependent and field-independent learners employ different cognitive processes during learning activities in classroom. Thus, teachers should use different approaches when teaching these two types of learners. Field-dependent learners like to establish strong relationship with teacher. They prefer teachers who are caring, warm and approval in nature. Teachers should use social and tangible rewards in order to motivate these types of learners. Teachers should use co-operative learning strategies because these learners prefer to interact and work with others during learning. Lessons and assignments should be properly structured and organised by teacher. For these learners, teacher should play the role of a lecturer, demonstrator, checker, re-enforcer, grader, and lesson designer.

For field-independent learners, teachers should be formal in their interactions with these learners. Teachers should show that they are the experts in the subject they are teaching. Teacher should use mastery learning strategy, and motivate these learners through non-social rewards, such as high grades. Allow these learners to structure and organise their work on their own. These learners prefer to work on their own, and teacher should give them independent projects. For these field-independent learners, the teacher should play the role of a consultant, listener, negotiator, and facilitator.

2.7.1 Kolb's Model of Learning Styles

After an elaborate and intensive study on learning styles, Kolb (1976,1984, 1985) proposed his model of learning style which is known as Kolb's Learning Styles Model. Kolb (1976) identified four learning styles which he called accommodation, assimilation, convergence and divergence. Accommodators, assimilators, convergers and divergers are names given to individuals whose learning styles are as mentioned respectively. Kolb developed his own learning style inventory in 1976, and later revised it in 1985. Kolb's learning style inventory is used as an instrument to identify students whether they are accommodators, assimilators, convergers or divergers.

Kolb's model of learning styles is theorised on the premise that individuals differ in learning according to how they perceive and process information and reality. Individuals differ in the way they perceive information and reality on a scale ranging from an orientation toward concrete experience to an orientation towards abstract conceptualisation. In the processing of information and reality, they differ on a scale ranging from an orientation toward reflective observation to an orientation toward active experimentation.

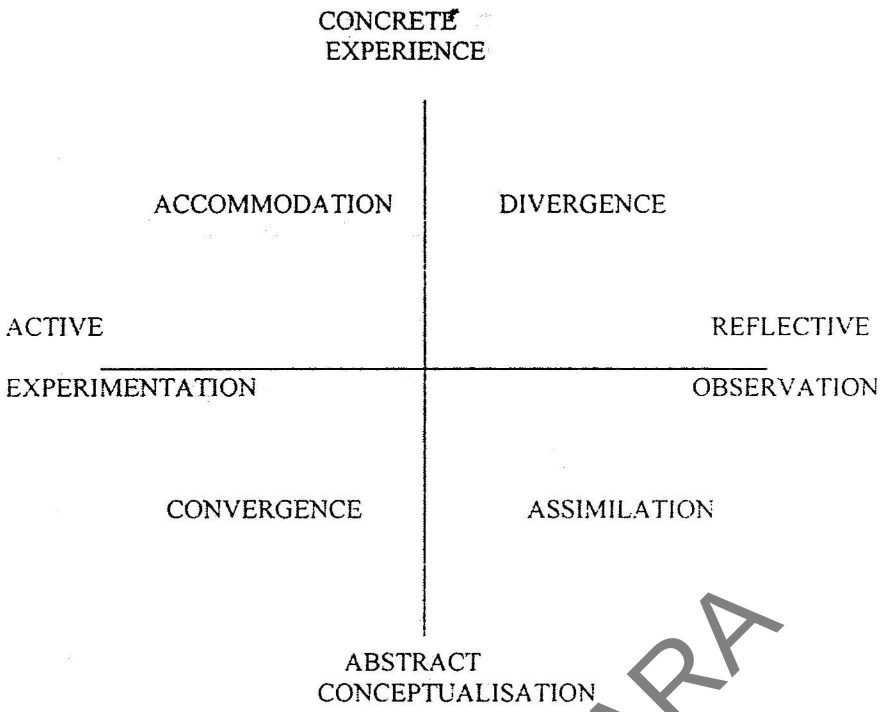


Figure 2.4 Kolb's Model of Learning Styles(1985)

In figure 2.4, the vertical axis represents the way individuals perceive information, which ranges from concrete experience to abstract conceptualisation. The horizontal axis represents the way how individuals process information, which ranges from active experimentation to reflective observation. The four quadrants represent the four learning styles: Quadrant one – divergence, quadrant two – assimilation, quadrant three – convergence, and quadrant four accommodation. Table 2.4 summarises the four learning styles and their modes of perceiving and processing information.

LEARNING STYLES	MODE OF PERCEIVING	MODE OF PROCESSING
DIVERGENCE	CONCRETE EXPERIENCE	REFLECTIVE OBSERVATION
ASSIMILATION	ABSTRACT CONCEPTUALISATION	REFLECTIVE OBSERVATION
CONVERGENCE	ABSTRACT CONCEPTUALISATION	ACTIVE EXPERIMENTATION
ACCOMMODATION	CONCRETE EXPERIENCE	ACTIVE EXPERIMENTATION

Table 2.1 Kolb's Learning Styles

In the Kolb's model, concrete experience, abstract conceptualisation, reflective observation, and active experimentation are called modes of learning. These four modes of learning are defined as follows:

1. Concrete experience

   In this mode of learning, learners focus on concrete objects, and relate learning materials to concrete situations and personal experiences. Feeling, as opposed to thinking, plays the major role in the learning process. These learners take an intuitive or artistic approach in learning activities. They are good intuitive decision makers, and they prefer to learn and work in unstructured situations. They are open-minded, and they like to relate to other people and get involved in real situations.

2. Abstract conceptualisation

This mode of learning focuses on abstract ideas and concepts using logic and reasoning. In learning activities, this type of learners emphasise thinking as opposed to feeling. These learners are good at learning abstract ideas and concepts. They can think and reason logically, and their approach in learning is more systematic and scientific, as opposed to intuitive or artistic. They are good at manipulation of abstract symbols, quantitative analysis, and analysing abstract ideas and concepts.

3. Reflective observation

Learners with this mode of learning focus on understanding the meaning of ideas, objects or situations by carefully watching and observing them. They emphasise on understanding through reflection, as opposed to action. They prefer learning activities which involve intuiting the meaning of ideas and situations, and seeing their implications. Being reflective and thoughtful, these learners can see things from different perspectives and appreciate different view points. Individuals who are oriented toward reflective observation are usually patient, impartial, considerate, and thoughtful in making decision or judgement.

4. Active experimentation

   Learners with active experimentation mode of learning prefer action. They emphasise on doing as opposed to observing. In learning situations, they focus on practical applications as opposed to reflective understanding. They enjoy doing activities and like to get things done.

Concrete experience and abstract conceptualisation are two contrasting modes of learning. They are the two ends of a continuum (the vertical axis in figure 2.4). Modes of learning of individuals may be anywhere on that continuum. Divergent and accommodative learning styles are more oriented toward concrete experience mode of learning. Assimilative and convergent learning styles are more oriented toward abstract conceptualisation mode of learning. Active experimentation and reflective observation are two ends of another continuum (horizontal axis in figure 2.4). Divergent and assimilative learning styles are more oriented toward reflective observation mode of learning. Convergent and accommodative learning styles are more oriented toward active experimentation mode of learning.

2.7.2 Characteristics of the four learning styles

- Convergent

The dominant modes of learning of individuals with convergent learning style are abstract conceptualisation and active experimentation. Individuals with this learning style are called convergers because they do best in situations like conventional intelligence tests, where there is a single correct answer to a problem. Convergers like learning materials which involve hypothetical-deductive reasoning. They are good at problem solving, decision making, and practical application of ideas. They are controlled in their expression of emotion, and they prefer activities which deal with technical tasks and problems rather than social and interpersonal issues.

Personality-wise, they are of the extraverted thinking type. Convergers are analytic, impersonal, objectively critical, and they put great emphasis on logic and reasoning. They are strict disciplinarians who follow rules and regulations. They are highly committed in work, and they hate confusion, inefficiency, halfway measures, and anything aimless and ineffective.

Convergers are competent in deciding skills which include creating new ways of thinking and doing, experimenting with new ideas, choosing the best solution, setting goals, and making decisions. Academically, they tend to specialise in areas related to science and technology, such as engineering. Career-wise, convergers prefer science-based professions where the jobs are technical in nature and require high degree of expertise. They are specialists in their areas of work. Engineers, doctors, computer programmers, medical technicians, and applied scientists are usually convergers.

- Divergent

Divergent learning style emphasises concrete experience and reflective observation as the modes of learning. Individuals with this learning style are called divergers because they perform well in situations that call for generation of alternative ideas and implications, such as a brainstorming session. Divergers have imaginative ability, and they can view concrete situations from many perspectives. They are feeling-oriented, and like to work with people. Personality-wise, divergers have a strong inclination toward introversion and feeling. They have a great sense of duty and obligation. They prefer work involving personal values.

Divergers are competent in valuing skills which include being sensitive to people's feelings and their values, listening with an open mind, gathering information, and imagining implications of uncertain situations. In schools and colleges, divergers like social sciences, and they tend to major in areas such as history, literature, language, political science, and psychology. Career-wise, they prefer jobs in arts, entertainment, and service organisations. Divergers tend to take up jobs such as actors/actresses, athletes, artists, musicians, designers, social workers, counsellors, therapists, and personnel managers.

- Assimilation

The dominant modes of learning of assimilative learning style are abstract conceptualisation and reflective observation. Individuals with this learning style are called assimilators because they are good at assimilating disparate observations into an integrated model. They have strong ability in inductive reasoning, which enable them to formulate theoretical models. Assimilators are less focused on people but are more concerned with ideas and abstract concepts. They do well in learning activities which involve abstract ideas and concepts. Assimilators are introverted and intuitive in their personality. With their intuitive insight and inner vision, assimilators are usually the great innovators in the field of ideas, principles and systems of thought. Strong determination, perseverance and endurance are personal qualities which enable assimilators to create new ideas and theoretical models.

Assimilators are competent in thinking skills which include organising information, building conceptual models, testing theories and ideas, designing experiments, and analysing quantitative data. Academically, assimilators prefer subjects which deal with abstract ideas and concepts. They tend to major in areas like mathematics, economics, chemistry, and physics. They prefer jobs which are related to their reflective and abstract conceptualisation capabilities. Mathematics and science teachers, writers, librarians, college professors, planners, research and development scientists, and researchers are usually assimilators.

- Accommodative

The dominant modes of learning of accommodative learning style are concrete experience and active experimentation. Individuals with this learning style are called accommodators because they are good at adapting to changing situations or circumstances. Accommodators like to carry out plans and tasks, and get involved in doing activities. They are oriented toward opportunity seeking, risk taking, and action. They take an intuitive trial-and-error approach in learning and problem solving activities. Accommodators are people oriented, and they are usually at ease working with people. Personality-wise, accommodators are extraverted and sensing in nature. Their personal characteristics are adaptable, realistic, good-natured, unprejudiced, open-minded, patient, easy-going, and tolerant of other people. They learn best from first-hand experiences than from books. They are good at doing things but not on written tests.

Accommodators are competent in areas involving acting skills, such as committing oneself to objectives, seeking and exploiting opportunities, influencing and leading others, an dealing and getting personally involved with people. Academically, accommodators tend to major in areas related to business, marketing and management. Career-wise, accommodators tend to choose social professions where they usually hold executive positions.

Managers, supervisors, public administrators, salespersons, public relations officers, and politician are usually individuals who have accommodative learning style.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter explains research design, sampling of respondents for the research. instruments of measurement and the procedures of constructing these instruments. Procedures of collecting data from the respondents and methods of statistically analysing the data are also explained in this chapter.

3.1 Comparative Survey Research Method

This research was carried out using comparative survey research method. The survey was cross-sectional in nature, where cross-sections of three different populations were studied at a single point in time. The survey was also comparative in nature. A comparative study and analysis of samples from three different populations were made. The respondents of this research were form five Malay students.

The three different populations of form five students were categorised as follows:

[1] Population of students who were very excellent in mathematics (VESG).

[2] Population of students who were good in mathematics (GSG).

[3] Population of students who were weak in mathematics (WSG).

Respondents were asked to answer an inventory of questionnaires. These questionnaires are of the close-form type, using likert scale from one to five.. These questionnares have been carefully constructed so that they are short, comprehensible and can be answered easily by the respondents. The number of questionnaires in each inventory have also been carefully decided so as not to take too much of respondents' time. The researcher went to the schools where the survey was undertaken. Questionnaires were distributed to the respondents through their mathematics teachers. The researcher sought the help and assistance from these mathematics teachers in supervising the answering session.

3.2 Respondents of Research (sampling)

The populations of this research were form five Malay students from secondary schools in Malaysia. Samples were chosen to represent the three different populations of secondary school students according to their levels of achievement in mathematics. To represent the population of students who were very excellent in mathematics, the researcher chose students from Maktab Rendah Sains MARA

(MRSM), Pengkalan Chepa, Kelantan. MRSM Pengkalan Chepa was chosen because it is one of the three MRSM in the country which has been selected for special education program. The other two are MRSM Taiping and Jasin. Students admitted into MRSM Pengkalan Chepa are selected from the very top of the group of students who qualify to study in MRSM. These students were categorised as very excellent students because of the following criteria:

(i) These students had performed very well in their PMR examination. All of them scored grade A in all the eight subjects, including mathematics and science, which they had taken in the examination.

(ii) These students scored high marks in the MRSM Entrance Test.

All form five students from MRSM Pengkalan Chepa were asked to answer the questionnaires. One hundred students were then randomly selected from this group. The random selection had to fulfil these two requirements:

(i) They had taken the whole tests and answered all the questionnaires. Respondents who did not answer any parts of the test, or who did not answer the tests satisfactorily (such as giving the same response to all the questionnaires) were rejected.

(ii) They scored high marks for additional mathematics in the SPM Trial Examination 1999.

This group of 100 students were the samples which represented the population of students who were very excellent in mathematics. They are labelled as VESG, in short for very excellent students group.

To represent the population of students who are good in mathematics, sampling was made from MRSM Kota Putra, Besut. These students were categorised as good but not excellent students according to these two criteria:

(i) Their PMR Examination results were not as good as the students who were selected into MRSM Pengkalan Chepa. Many of these students scored only six As in the PMR Examination. Six As (including mathematics and science) and two Bs are the minimum requirements for entrance into MRSM.

(ii) Their scores in The MRSM Entrance Test were not very high.

All form five students from MRSM Kota Putra were given the tests. Then, 100 students were randomly selected according to these two requirements:

(i) The students had taken the whole test and answered all the questionnaires satisfactorily. This is the same as the first requirement for selecting VESG.

(ii) The scores that the students got for additional mathematics in the Trial SPM examination 1999 were in the medium range. The rationale for selecting the medium range scores was to reduce the chances of having students who were similar to students in the very excellent students group (VESG) or the weak students group.

These 100 randomly selected students from MRSM Kota Putra were the samples which represented the population of good students. They are labelled as GSG, in short for good students group.

To represent the population of students who are weak in mathematics, sampling was made from a few schools which were known to have low-performing students. The majority of these students had problems in learning mathematics. The population of these problematic students were found in many daily schools, especially in the rural areas. These students had performed very badly in PMR examination.The researcher was able to get about 300 weak students from daily schools in the district of Kuala Terengganu such as Sekolah Menengah Kompleks, Wakaf Tengah, Sekolah Menengah Tengku Mizan, Maras and Sekolah Menengah Ibrahim Fikri, Seberang Takir.

These students were asked to take the tests. From these 300 weak students, 100 students were randomly selected, and they were the samples which represented the population of weak students (WSG). The random selection had to fulfil these two requirements:

(i) They must have taken the whole tests and answered all the questionnaires satisfactorily. Respondents who failed to do so were rejected.

(ii) They got low scores for additional mathematics in the Trial SPM examination 1999. This was to make sure that they really represented the group of students who were weak in mathematics.

The three different populations, and the sampling process described above are illustrated in figure 3.1.

POPULATION : VESG
SAMPLE : 100 STUDENTS
FROM MRSM PENG. CHEPA

POPULATION : GSG
SAMPLE : 100 STUDENTS
FROM MRSM KOTA PUTRA

POPULATION: WSG
SAMPLE : 100 STUDENTS
FROM ORDINARY SCHOOLS

Figure 3.1 Population and Sampling

3.3 Instruments of Research

There are eight variables involved in this research. One is a dependent variable, and the other seven are independent varibles. The instruments for measuring these variables are discussed in this section. This research was carried out in Bahasa Melayu (Malay language). The Bahasa Melayu version of the instruments described here are given in appendix.

3.3.1 Students' Achievements in Mathematics (SAM)

This is the dependent variable of the research. The researcher was able to get the scores that these students got for mathematics and additional mathematics in Trial SPM 1999 examination from the mathematics department of the schools involved. SAM is the mean of the scores that they get for mathematics and additional mathematics. These scores can be considered valid and reliable measuremets of students' relative abilities in mathematics because Trial SPM papers are standardized according to the actual SPM examination papers in terms of content and format.

3.3.2 Attitudes Towards Mathematics

The instrument for measuring attitudes towards mathematics is an inventory of close-form questionnaires using likert scale. The students were given the questionnaires, and they were asked to respond by selecting one of these choices: 1. Strongly disagree 2. Disagree 3. Uncertain 4. Agree 5. Strongly agree

To ensure the validity of the instrument, questionnaires were carefully constructed so that attitudes can be inferred through responses to these questionnaires. Triandis (1971) and Ajzen (1988) viewed attitude as a multi-dimensional construct which includes cognitive, affective and conative components. The researcher included these three components in constructing the questionnaires. These questionnaires include expressions of beliefs, feelings and behavioural intentions towards mathematics. Attitudes test inventory consists of these ten questionnaires:

1. Mathematics is useful in everyday life.
2. Mathematics is a difficult subject to learn.
3. Mathematics is an interesting and stimulating subject.
4. Mathematics is a subject which I like.
5. I enjoy and feel happy learning mathematics.
6. I always feel sleepy and lose concentration in mathematics class.
7. I like to solve mathematics problems which are difficult and mentally challenging.
8. I always do mathematics exercises and finish mathematics homework given by my teacher.
9. I have never been absent from mathematics class without reason.
10. If given a choice, I do not want to learn mathematics.

The questionnaires above were purposely stated either positively or negatively in order to avoid leading the respondents towards a specific answer. When entering the data in SPSS, the responses to negative statements will be decoded. High total scores in the attitudes test indicate positive attitudes towards mathematics. Reliability test was conducted before this instrument was used for the research. This inventory of questionnaires were be given to a sample of sixty students.

Reliability analysis was then carried out to determine if any of these ten items had to be omitted.

3.3.3 Mathematics Anxiety

The instrument for measuring mathematics anxiety was an inventory of close-form questionnaires using likert scale similar to the attitudes test. In constructing these questionnaires, the researcher gave careful thoughts and considerations to the cognitive, affective and physiological aspects which are related to anxiety. This was to ensure that the contents of the questionnaires are valid for the purpose of measuring mathematics anxiety. Through responses to these questionnaires, we can infer the level of mathematics anxiety of the students. The mathematics anxiety test is an instrument consisting of the following questionnaires:

1. I feel happy and enjoyable when the time comes for mathematics class.
2. When in mathematics class, my thoughts and feelings are always calm and peaceful.
3. I do not feel nervous or afraid when asked to answer questions in mathematics class.
4. Even though sometimes difficult to understand, I am not afraid of mathematics.
5. Mathematics is not one of the subjects which incites the feeling of fear, worry or uneasiness in me.

6. Among the teachers who teach me, mathematics teacher is one of the teachers whom I am very afraid of.
7. I am always worried and afraid of mathematics tests.
8. I feel very pressured because of too much exercises and homeworks given by my mathematics teacher.
9. I frequently experienced tensed feeling such as racing heart beat while in mathematics class.
10. I feel very anxious and afraid of mathematics, and this has led me to totally ignore this subject.

When entering data in SPSS, responses for questionnaires which were stated negatively, were decoded. High total scores indicate low level of mathematics anxiety. Like the attitudes test, mathematics anxiety had to undergo reliability test first before it was used for the research. Unreliable items were then omitted.

3.3.4 Personality and Behavioural Characteristics

The instrument for measuring this variable was an inventory of close-form questionnaires using likert scale similar to the two instruments mentioned above. Students need to have certain personality and behavioural characteristics in order to succeed in learning mathematics. This instrument measures whether the students possess these characteristics or not. In constructing the inventory of questionnaires, the researcher looked into the structure of mathematical knowledge and carefully considered what kind of personality and behaviours that students should possess in order to succeed in acquiring this knowledge. For example, mathematics involves abstract reasoning, thus it requires personality which is rational, logical but not emotional in nature.

Mathematical knowledge is hierachical in nature, thus students who have the habit of procrastination will encounter difficulties in learning the subject. Mathematics is sometimes difficult to understand, thus students cannot be shy and passive. They must ask questions, and play an active role by engaging in discussions and problem solving activities.

These are the aspects which the researcher considered when constructing this instrument. Personality and behavioural characteristics test is an instrument consisting of the following questionnaires:

1. I do not like to postpone doing work given by my mathematics teacher.
2. I always finish mathematics homework on time as required by teacher.
3. I always follow mathematics lessons properly so as not to be left behind.
4. I have my own orderly study timetable.
5. I am not shy to ask my mathematics teacher whenever there is something I do not understand, or if there is a question I cannot answer.
6. I like to ask and discuss with my friends when I study or do mathematics exercises.
7. Whenever I do something, I do it carefully and not hurriedly.

8. Before doing something, I like to think logically, rationally, carefully and deeply, and not according to my emotions.
9. Personality-wise, I am calm, peaceful and trust-worthy.
10. I like to act according to my emotions, and have done many wrong things which are against the rules of the school.

Responses to the questionnaires which were stated negatively were decoded. Total scores were then calculated. High total scores indicate positive personality and behavioural characteristics. Like the two instruments above, this instrument had to undergo reliability test first before it was used for the research.

3.3.5 Motivation to Study Mathematics

The instrument for measuring motivation to study mathematics was an inventory of close-form questionnaires using likert scale similar to the three instruments mentioned above. In contructing this instrument, the researcher carefully considered various factors, both instrinsic and extrinsic, which drive the students to succeed in learning mathematics. The instrument for measuring this variable is an inventory of the following questionnaires:

1. I have a strong commitment to achieve good grade for mathematics in the coming SPM examination.

2. I enjoy the challenge of having to achieve high scores in mathematics tests given by my teacher.
3. I like to do work involving calculation, figures, and diagrams.
4. Success in solving mathematics questions or problems gives satisfaction to me.
5. I like learning activities which are mentally challenging such as solving mathematical problems.
6. I am not afraid of facing challenge and competition from other students in achieving excellence.
7. Through hard work and effort, I can achieve high grade in mathematics.
8. Only a few intelligent and gifted students can achieve high grades in mathematics.
9. Success or failure is determined by my own self, and not other people.
10. I want to achieve excellence because I like to be recognised, praised, appreciated, and respected by friends, teachers, and others in my society.

Responses to questionnaires which were stated negatively were decoded so that high total scores indicated high motivation. Like the earlier instruments, this instrument had to undergo a reliability test before it was used for the research. Some of the items were omitted when they were found unsuitable after reliability analysis had been made.

3.3.6 Learning Strategies

The instrument for measuring learning strategies is an inventory of close-form questionnaires using the likert scale like the above four instruments. Learning strategies range from the very crude method of rote-memorising to the more sophisticated method of meaningful learning. The questionnaires were carefully constructed so that from the responses given, we can infer the students' learning strategies. The instrument consists of the following questionnaires:

1. I learn mathematics by memorising important facts, rules, formulas, and procedures which are found in mathematics.
2. I do a lot of drilling exercises in order to raise my performance in mathematics.
3. I do not stress understanding. The important thing is I remember and can carry out the steps in solving the problems, as taught by the teacher, so that I will get the correct answer.
4. I study hard only when mathematics test is near.
5. The purpose of why I study is to succeed in tests or examinations.
6. I give an effort to understand fully every mathematics lesson.
7. I ask my teacher and discuss with my friends in order to gain meaning of the mathematics learning material.
8. I study every mathematics lesson carefully and in depth until it becomes meaningful to me.

9. Mathematics is a subject about numbers, symbols, rules, formulas, and procedures which must be memorised and remembered by every student.
10. Mathematics requires students to think intelligently, rationally, and logically so that they can understand abstract concepts.

Some of the responses were decoded so that high total scores indicate an orientation towards meaningful learning strategies, and low total scores indicate an orientation towards rote-memorisation learning strategies. Relialibilty test was carried on this instrument before was used for the research.

3.3.7 Cognitive Readiness

According to Piagetian theory of cognitive development, from age twelve onwards students have progresed from concrete operational to formal operational stage of cognitive development. At this formal operational stage, students have developed cognitive structures which enable them to deal with not only concrete but also abstract objects, concepts and ideas. Formal operational students are able to think logically about abstract and hypothetical situations, and make generalisations. They can understand "if-then" relationships, think in symbolic terms, and are able to perform hypothetical-deductive reasoning. Cognitively, these students are ready to learn mathematical concepts and ideas which are abstract and symbolic in nature.

To succeed in learning mathematics, students must be cognitively ready for the subject. The researcher designed a cognitive readiness test as an instrument to measure students' cognitive readiness to learn mathematics. This instrument was designed to measure cognitive abilities with respect mathematics. Cognitive abilities which were considered relevent in the learning of mathematics are abstract reasoning, logical thinking, numerical computations, problem solving, and abilities to recognize and interpret symbols and patterns. In designing the instrument, the researcher referred to intelligent quotient tests by Eysenck and Evans (1996). Questions which are related to abstract reasoning, logical thinking, and numerical abilities were selected and adapted from the IQ tests by Eysenck and Evans (1996).

The cognitive readiness test is an instrument consisting of eighteen questions involving abstract reasoning, logical thinking, and numerical abilities. The eighteen questions for the test consist of:

1. Two questions on logical thinking.
2. Eight questions on abstract reasoning, which includes four questions on recognising and interpreting patterns of number sequences and four questions on recognising and interpreting abstract symbols and patterns.
3. Eight questions on numerical and computational abilities.

These questions are given in appendix B. Reliability test and items analysis were carried out first before this instrument was used for the research. Through items analysis, questions which were found unsuitable or unreliable, were identified and omitted.

3.3.8 Learning Styles

The instrument of measurement for this variable is Kolb's Learning Style Inventory (1985). Kolb (1985) designed this learning style inventory for determining students' learning styles. This inventory consists of twelve items. Each item begins with a statement followed by a choice of four endings which relate to the four modes of learning as proposed by Kolb (1985) : Concrete experience (CE), abstract conceptualization (AC), active experimentation (AE), and reflective observation (RO). Respondents were asked to rank these endings from 1 (least like my way of learning) to 4 (describes my way of learning best). The students' preferred mode of learning can be identified by the total scores that they get for CE, AC, AE and RO. Kolb's learning style inventory is shown in appendix C.

There are four learning styles: Accommodation, divergence, assimilation and convergence. Students' learning styles can be determined by the following procedures:

1. Calculate the total scores for CE, RO, AC and AE. These are the total scores for ranks given by respondents in columns 2 to 5.

2. Calculate: AE – RO. This is the value for the horizontal axis in figure 3.2.
3. Calculate: CA – CE. This is the value for the vertical axis in figure 3.2.
4. Plot the values from (2) and (3) on the axes in figure 3.2 to determine the learning style.

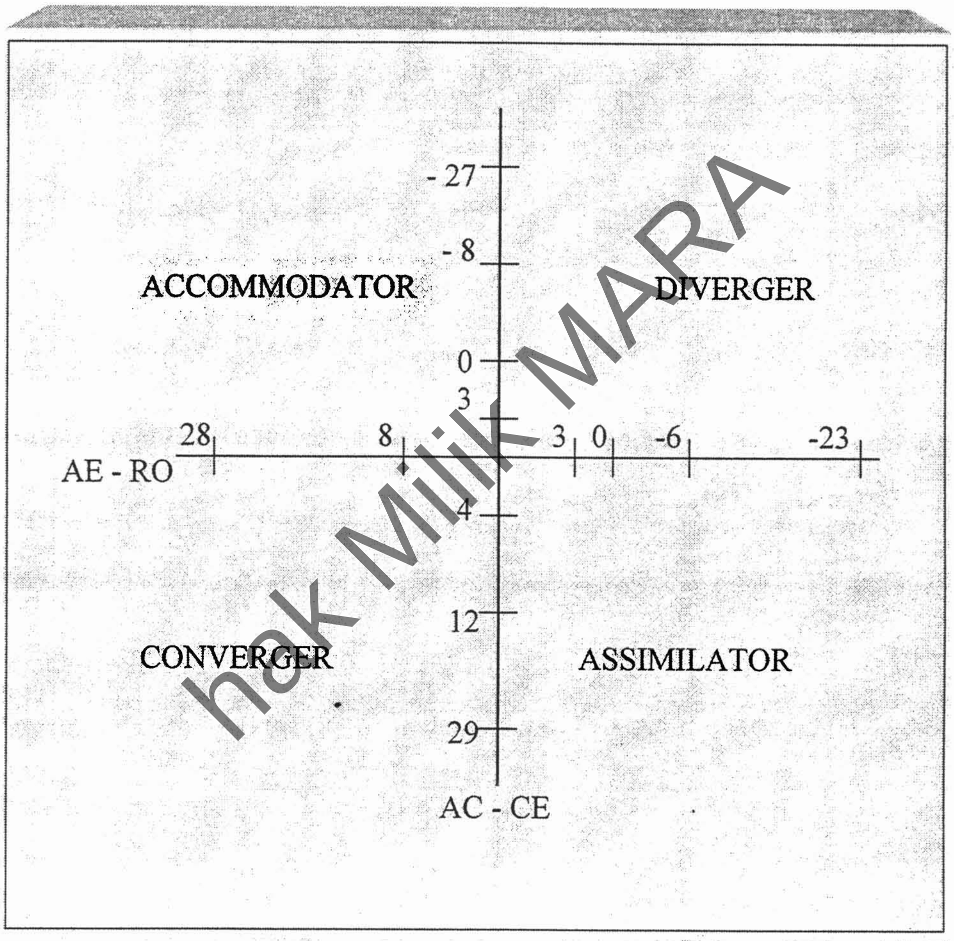


Figure 3.2 Learning Styles Type Grid

3.4 Validity and Reliability of Instruments

To ensure validity and reliability of instruments used, the researcher carried out an extensive and careful study about the nature of all the variables which were to be investigated. To ensure validity, careful considerations were made in constructing questionnaires so that, content-wise, they are valid and serve as a valid measure for the variables involved.. The questionnaires were carefully constructed so that they are easy to understand and can be answered easily by respondents. The researcher studied inventories of instruments that have been used and tested by other researchers who have conducted research involving these variables.

To ensure reliabilty, these instruments were first tested on a group of sixty students. Responses to the questionnaires in the instruments by this group of students were analysed. The reliabilty analysis was carried out using SPSS. Each item in the instrument was analysed through the process of items analysis. Items which were not suitable or not reliable were omitted. After the analysis, changes or corrections were made. Then only these instruments were used for the research.

3.5 Analysis of Data

The data collected was analysed using SPSS. The main questions of the research were to determine whether significant correlation exists between the dependent variable, SAM, and the other seven independent variables. For inter groups comparison, the main questions were to determine whether the mean scores for the seven independent variables are significantly different for the three groups. Finally, multiple regression analysis was carried out to get an equation which relates SAM with the seven independent variables.

There were three types of statistical analyses which were carried out using SPSS for Windows Version 9.05 :

1. Correlation (using Pearson correlation). The correlation coefficients between SAM and the seven independent variables – attitudes towards mathematics, mathematics anxiety, motivation to study mathematics, personality and behavioural characteristics, cognitive readiness, learning strategies, and learning styles – were calculated. Significant tests were also carried out to determine whether the correlation coefficients were significant or not at 0.05 or 0.01 level.

2. Comparing means (using multiple comparisons Post Hoc Tests). The analyses carried out were to determine whether the means that the three groups, VESG, GSG and WSG, scored were significantly different or not.

3. Multiple regression. Through the multiple regression analysis, an equation, which relates SAM with the seven independent variables, was obtained. This equation can be used for prediction purposes.

CHAPTER 4

RESEARCH FINDINGS AND ANALYSIS OF DATA

This chapter discusses the process of collecting data, sampling, reliability and items analysis in designing the instruments for measuring the variables, and finally the analysis of data. The analysis of data involved correlation tests, multiple comparisons tests, and multiple regression analysis.

4.1 Collection of Data

Data were collected from three non-homogenous groups of form five students who were identified as very excellent students group, good students group, and weak students groups. The criteria for determining these three groups were already discussed in chapter three. The researcher went to these schools, and with the help of the heads of mathematics units of the schools, the researcher was able to carry out the survey. The schools involved in the research were :

1. Maktab Rendah Sains MARA, Pengkalan Chepa (282 students)
2. Maktab Rendah Sains MARA, Kota Putra, Besut (302 students)

3. Sekolah Menengah Ibrahim Fikri, Seberang Takir, Kuala Terengganu (41 students)

4. Sekolah Menengah Kompleks, Mengabang Telipot, Kuala Terengganu (67 students)

5. Sekolah Menengah Tengku Mizan, Maras, Kuala Terengganu (133 students).

All the students who took part in the survey were science stream students who took additional mathematics for their SPM examination. Since the survey was divided into two parts, and given at two different times, many students did not return both the questionnaire papers. After checking through all questionnaire papers that were returned, many papers had to be rejected because of the following reasons:

- Only one part of the survey was returned
- Many items in the survey were not answered.
- Names were not written so the two parts of the survey could not be identified as belonging to any particular student.
- The questionnaires were not properly or seriously answered such as giving the same number responses (such as all 5s or all 1s) to all questions.
- Mathematics and additional mathematics scores for the trial SPM 1999 examination of the students were not known or available.

All the survey papers returned were examined to determine whether they could be accepted or rejected. The number of papers returned, rejected and accepted is shown in table 4.1 below:

Table 4.1 Number of Papers Returned, Rejected and Accepted

Name of school	Papers returned	Papers rejected	Papers accepted
Maktab Rendah Sains MARA Pengkalan Chepa	257	10	247
Maktab Rendah Sains MARA Kota Putra	280	14	266
Sekolah Menengah Ibrahim Fikri Kuala Terengganu	41	8	33
Sekolah Menegah Kompleks Kuala Terengganu	64	7	57
Sekolah Menegah Tengku Mizan Kuala Terengganu	124	16	108

4.2 Sampling Process

Very Excellent Students Group (VESG)

One hundred questionnaire papers were randomly selected from the 247 acceptable papers returned by the students of Maktab Rendah Sains MARA, Pengkalan Chepa. To ensure that these samples represented very excellent students, the random selection had to fulfill the requirement that the students' scores for additional mathematics in the trial SPM examination must be above

50%. Students who answered the survey papers satisfactorily and scored more than 50% in additional mathematics were isolated from the rest, and 100 papers were randomly selected from this group.

Good Students Group (GSG)

After examining all the survey papers returned by students of Maktab Rendah Sains MARA Kota Putra, Besut, 266 papers which, were satisfactorily answered, were obtained from this school. Then 100 papers were randomly selected as samples to represent good students group. To ensure that the samples represented good students with average ability in mathematics, only students who scored between 30% and 50% for additional mathematics were randomly selected.

Weak Students Group (WSG)

The total number of survey papers returned from Sekolah Menengah Ibrahim Fikri, Sekolah Menengah Tengku Mizan and Sekolah Menengah Kompleks was 229. After examining the papers, the researcher was able to get 198 papers which were answered satisfactorily and acceptable for the research.. Then, 100 papers were randomly selected as samples to represent the weak students group. To ensure that the samples represented weak students, only students who scored below 30% for additional mathematics in the trial SPM examination were randomly selected.

4.3 Reliability Analysis

To determine reliability, the instruments were tested on a sample of sixty form five students from the same population groups. Reliability analysis was conducted on the instruments using SPSS 9.05 for Windows. The reliability analysis included analysis for all items in the instruments. The details of the analysis are given in appendix. This section discusses the results of the analysis.

Attitudes Towards Mathematics Test

Reliability test using scale alpha was carried out on the instrument involving all the ten items. The alpha coefficient for the instrument, which included all the ten items, was 0.7760. After analysing all the items, the researcher decided to omit item 1 and 9. Item 1 had the highest mean of 4.7667 (maximum is 5) and a relatively low standard deviation of 0.6207. This means that almost all the respondents gave the score of five for this questionnaire. Item 1 also had a low item-total correlation of 0.1742. Item 9 was omitted because it also had a low item-total correlation of 0.2990, which was second lowest after item 1.

Reliability test was again carried out on the instrument using the remaining eight items. The alpha coefficient with these eight items was 0.7856, which was higher than the alpha coefficient with ten items. Thus, the instrument for measuring attitudes towards mathematics would include only eight items. Item 1 and 9 were omitted.

Mathematics Anxiety Test

Reliability test using scale alpha was carried out on this instrument involving all the ten items. The alpha coefficient for this instrument was 0.7706. All items had positive and relatively high item-total correlation coefficients. Thus, the researcher decided to retain all the ten items for this instrument.

Personality and Behavioural Characteristics Test

Reliability test using scale alpha was carried out on this instrument involving all the ten items. The alpha coefficient for this instrument was 0.8114. All items had positive item-total correlation coefficients. Thus, all the ten items were used for the instrument.

Motivation to Study Mathematics Test

When all the ten items were included in the reliability test using scale alpha, the alpha coefficient obtained was 0.5283, which was quite low in term of reliability. After analysing all the items, this low alpha coefficient was due to items 9 and 10. Both items 9 and 10 had negative item-total correlation coefficients. After omitting these two items, a satisfactory alpha coefficient of 0.7212 was obtained. Thus, items 9 and 10 were omitted, and the final instrument was consisted of the remaining eight items.

Learning Strategies Test

With all the ten items were included, the instrument gave an alpha coefficient of 0.6739. Looking at the item-total statistics, items 5 and 10 were found to be unsuitable because they had very low item-total correlation coefficients of 0.0824 and 0.1369 respectively. When these two items were omitted, an alpha coefficient of 0.7212 was obtained. Thus, items 5 and 10 were omitted, and the final instrument was consisted of the remaining eight items.

Cognitive Readiness Test

Eighteen items were constructed for this instrument. The reliability test using all the eighteen items gave an alpha coefficient of 0.5672. After analysing all the items, items 3, 9 and 11 are found to be unsuitable. Item 9 had a mean of 1 and standard deviation 0, which means that all respondents got the correct answer for this question. In the item-total statistics, item 9 had 0 item-total coefficient. Items 3 and 11 had negative item-total correlation coefficients. After omitting these three items, the instrument gave an alpha coefficient of 0.6297. Thus, items 3, 9 and 11 were omitted, and the final instrument was consisted of the remaining 15 items.

Learning Styles

The instrument for determining learning styles is Kolb's Learning Styles Inventory. This inventory has been used and tested by many researchers in determining learning styles. It has been found to be highly reliable with alpha coefficient between 0.81 and 0.87 (Willcoxson & Prosser, 1996).

4.4 Analysis of Research Data

The analyses conducted are in the form correlation (using Pearson correlation), multiple comparisons (using ANOVA and Post Hoc Tukey HSD Tests), and multiple regression analysis. The details of the analyses are shown in the appendix. This section discusses the results of the analyses. The results of correlation tests and multiple comparison tests are shown in table 4.2 and 4.3 respectively.

Table 4.2 Results of Correlation Tests

VARIABLE			Pearson Correlation (with SAM)	Significant test(2-tailed)
Attitudes towards mathematics			0.479	0.000
Mathematics anxiety			0.342	0.000
Motivation to study mathematics			0.381	0.000
Personality & behavioural characteristics			0.137	0.018
Cognitive readiness			0.557	0.000
Learning strategies			0.421	0.000
Learning style :	(i)	CE	- 0.298	0.000
	(ii)	AC	0.275	0.000
	(iii)	RO	- 0.125	0.031
	(iv)	AE	0.115	0.047

Table 4.3 Results of Multiple Comparisons Tests

VARIABLE	VES - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Attitudes towards mathematics	- 0.01	1.000	3.58	0.000	3.59	0.000
Mathematics anxiety	- 1.44	0.11	2.89	0.000	4.33	0.000
Motivation to study mathematics	0.18	0.931	3.17	0.000	2.99	0.000
Personality and behavioural characteristics	- 2.03	0.008	0.95	0.345	2.98	0.000
Cognitive readiness	0.89	0.016	4.11	0.000	3.22	0.000
Learning strategies	- 1.4	0.040	3.41	0.000	4.81	0.000
Learning style: AC	0.97	0.525	3.69	0.000	2.72	0.007

Note: The number 0.000 in the fourth column is a rounded figure for p-value < 0.00005.

4.4.1 Results of Correlation Tests

The correlation coefficients were calculated using Pearson correlation. The correlation coefficients, which were calculated, were the correlation between SAM and the seven independent variables. The results obtained were as follows:

SAM and Attitudes Towards Mathematics

Table 4.4 Correlation between SAM and Attitudes Towards Mathematics

Variable	Pearson Correlation	Sig. test (2- tailed)
Attitudes towards mathematics	0.479	0.000

SAM (students achievements in mathematics) were positively related with attitudes towards mathematics. The Pearson correlation coefficient between SAM and attitudes towards mathematics was 0.479. The two-tailed significant test gave the p-value of less than 0.00005 (in the output, this figure is rounded to 0.000), which means that this correlation is significant at 0.01 level. Thus, null hypothesis number 1, which states that there is no significant relationship between SAM and their scores in the test of attitudes towards mathematics, is rejected. This finding confirms hypothesis 1 which states that students with higher achievements in mathematics will have higher scores in the test of attitudes towards mathematics. High scores in the test of attitudes towards mathematics indicate positive attitudes towards the subject. Therefore, this finding suggests that mathematics achievements can be enhanced by fostering positive attitudes towards the subject.

SAM and Mathematics Anxiety

Table 4.5 Correlation between SAM and Mathematics Anxiety

Variable	Pearson Coefficient	Sig. Test (2- tailed)
Mathematics anxiety	0.342	0.000

The correlation test showed that there was a positive relationship between SAM and their scores in mathematics anxiety test. The Pearson correlation coefficient between SAM and mathematics anxiety was 0.342. The two-tailed significant test gave the p-value < 0.00005, which means that the correlation is significant at 0.01 level. Thus null hypothesis number 2, which states that there is no significant relationship between SAM and their scores in mathematics anxiety test, is rejected. This finding confirms hypothesis 2 which states that, students with higher achievements in mathematics will have higher scores in mathematics anxiety test. High scores in mathematics anxiety test indicate low level of mathematics anxiety. This finding suggests that in order to raise students' achievements in mathematics, efforts must be made to reduce their level of mathematics anxiety.

SAM and Motivation to Study Mathematics

Table 4.6 Correlation between SAM and Motivation to Study Mathematics

Variable	Pearson correlation	Sig. Test (2-tailed)
Motivation to study mathematics	0.381	0.000

The correlation test showed that there was a positive relationship between SAM and motivation to study mathematics. The Pearson correlation coefficient between the two variables was 0.381. The two-tailed significant test gave the p-value < 0.00005, which means that the correlation is significant at 0.01 level. Thus, null hypothesis number 3, which states that there is no significant relationship between these two variables, is rejected. This finding confirms hypothesis 3, which states that students with higher achievements in mathematics will have higher scores in the motivation to study mathematics test. High scores indicate that the students have strong motivation to study mathematics. This finding suggests that mathematics achievements can be raised by enhancing students' motivation to study the subject.

SAM and Personality and Behavioural Characteristics

Table 4.7 Correlation between SAM and Personality & Behavioural Characteristics

Variable	Pearson correlation	Sig. Test (2-tailed)
Personality & behav. characteristics	0.137	0.018

The correlation test showed that there was a positive relationship between SAM and their scores in the personality and behavioural characteristics test. Even though the Pearson correlation coefficient was low (0.137), it was significant. The two-tailed significant test gave the p-value = 0.018, which means that the correlation was significant at 0.05 level. Thus, null hypothesis number 4, which states that there is no relationship between SAM and their scores in the personality and behavioural characteristics test, is rejected. This result confirmed hypothesis 4 which states that students with higher achievements in mathematics will have higher scores in the personality and behavioural characteristics test. High scores mean that the students have positive personality and behavioural characteristics such as hardworking, always finishing work on time, obedient and patient. This finding suggests that by promoting and fostering these positive personal qualities, mathematics achievements can be enhanced.

SAM and Psychological Readiness

Table 4.8 Correlation between SAM and Psychological Readiness

Variable	Pearson correlation	Sig. Test(2-tailed)
Psychological readiness	0.404	0.000

Psychological readiness was not a variable by itself. Students' psychological readiness towards learning mathematics was determined by the above four variables: Attitudes towards mathematics, mathematics anxiety, motivation to study mathematics, and personality and behavioural characteristics. The score for psychological readiness was obtained by taking the sum of the scores for the four variables.

The correlation test showed that psychological readiness was positively related with SAM. The Pearson correlation coefficient was 0.404. The two-tailed significant test gave the p-value < 0.00005, which means that the correlation was significant at 0.01 level. This finding suggests that students with higher achievements in mathematics have a higher level of psychological readiness towards learning the subject.

SAM and Cognitive Readiness

Table 4.9 Correlation between SAM and Cognitive Readiness

Variable	Pearson correlation	Sig. Test(2-tailed)
Cognitive readiness	0.557	0.000

The correlation test showed that SAM was positively related with the scores that they got in cognitive readiness test. The Pearson correlation coefficient was 0.557, which was the highest compared to coefficients for the other variables. The two-tailed significant test gave the p-value < 0.00005, which means that the correlation was significant at 0.01 level. This means that null hypothesis number 5, which states that there is no relationship between SAM and their scores in cognitive readiness test, is rejected. This confirms hypothesis 5: Students with higher achievements in mathematics will have higher scores in cognitive readiness test. This finding suggests that students can raise their performance in mathematics by improving their skills in abstract reasoning, logical thinking and numerical computations.

SAM and Learning Strategies

Table 4.10 Correlation between SAM and Learning Strategies

Variable	Pearson correlation	Sig. Test(2-tailed)
Learning strategies	0.421	0.000

The correlation test showed that SAM and their scores in learning strategies test were positively related. The Pearson correlation coefficient was 0.421. The two-tailed significant test gave the p-value < 0.00005, which means that the correlation was significant at 0.01 level. Thus, null hypothesis number 7, which states that there is no relationship between SAM and their scores in the learning strategies test, is rejected. The significant positive correlation shows that students with higher achievements in mathematics score higher in the learning strategies test. Higher scores indicate that the students are oriented towards meaningful learning as opposed to rote-memorising. This finding suggests that mathematics achievements can be improved if the students do not just rote-memorise their learning materials. Instead, they should strive for meaning and understanding in what they are learning.

SAM and Learning Styles

Table 4.11 Correlation between SAM and Learning Styles

Variable	Pearson correlation	Sig. Test(2-tailed)
Learning styles : (1) CE	- 0.298	0.000
(2) AC	0.275	0.000
(3) RO	- 0.125	0.031
(4) AE	0.115	0.047

Learning styles involved these four modes of learning: Concrete experience (CE), abstract conceptualisation (AC), reflective observation (RO) and active experimentation (AE). The correlation tests showed that SAM had significant correlation with these four modes of learning. SAM were negatively related with CE and RO. The Pearson correlation coefficients for CE and RO were - 0.298 and – 0.125 respectively. The two-tailed significant tests gave the p-value < 0.00005 for CE and p-value 0.031 for RO. This means that the correlation for CE and SAM, and RO and SAM were significant at 0.01 and 0.05 level respectively.

SAM were positively related with AC and AE, and the Pearson coefficients were 0.275 and 0.115 respectively. The two-tailed significant tests gave the p-value < 0.00005 for AC and p-value 0.047 for AE. This means that the correlation for AC and SAM, and AE and SAM were significant at 0.01 and 0.05 level respectively.

Therefore, these two null hypotheses: (1) There is no relationship between SAM and AC, and (2) there is no relationship between SAM and RO, are rejected.

The correlation test results showed that mathematics achievements were positively related with active experimentation mode of learning. This finding suggests that mathematics require students to be active and not just reflective. This is because in mathematics, they need to discuss and ask questions, do lots of exercises, and solve all types of mathematical problems. Mathematics achievements were positively related with abstract conceptualisation mode of learning. This finding confirms not only hypothesis 6, but also the general view that mathematical knowledge is abstract by nature and thus it requires students to be able to engage in learning activities which involve abstract conceptualisation.

4.4.2 Results of Multiple Comparisons Tests

This section discusses the results of the inter groups comparisons. The mean scores of the seven variables that the three groups got were analysed to determined whether these means were significantly different. The comparisons were carried out using ANOVA and Post Hoc Tukey HSD Tests. The results obtained were as follows:

Attitudes Towards Mathematics

Table 4.12 Mean Differences of Attitudes Towards Mathematics

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Attitudes towards mathematics	- 0.01	1.000	3.58	0.000	3.59	0.000

The test gave an unexpected result of – 0.01 for the mean difference between VESG and GSG (VESG – GSG). The researcher expected to see a positive difference because students in VESG should have more positive attitudes than the students in GSG. However, the difference in the means of these two groups was very small, and the significant test gave the p-value = 1.000, which means that it was not significant at 0.05 level.. Thus the null hypothesis, H_0 : Mean VESG – mean GSG = 0 (there is no difference in the means of VESG and GSG) cannot be rejected. The attitudes towards mathematics of VESG and GSG are not significantly different.

For VESG and WSG, the mean difference was 3.58, and the significant test gave the p-value < 0.00005, which means that the difference is significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean VESG – mean WSG = 0 (there is no difference in the means of these two groups) is rejected. This confirms the hypothesis that the mean for VESG is greater than the mean for WSG. The students in VESG have a more positive attitude towards mathematics than the students in WSG.

For GSG and WSG groups, the result showed that the mean for GSG was greater than the mean for WSG by a difference of 3.59. The significant test gave the p-value < 0.00005, which means that the difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean GSG – mean WSG = 0 (there is no difference in the means of GSG and WSG) is rejected. This confirms the hypothesis that the mean for GSG is greater than the mean for WSG. Students in GSG have a more positive attitude towards mathematics than the students in WSG.

Mathematics Anxiety

Table 4.13 Mean Differences of Mathematics Anxiety

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Mathematics anxiety	- 1.44	0.113	2.89	0.000	4.33	0.000

For mathematics anxiety test, higher scores indicated a lower level of mathematics anxiety. The difference in means for mathematics anxiety test scores between VESG and GSG was - 1.44. This is unexpected because the researcher expected to see a positive difference to indicate VESG has a lower level of mathematics anxiety than GSG. However, the difference was not significant at 0.05 level, as indicated by the p-value = 0.113. Thus, the null hypothesis, H_0 : Mean VESG – mean GSG = 0, cannot be rejected. The levels of mathematics anxiety between these two groups of students are not significantly different.

For VESG and WSG, the difference was 2.89, and it was significant at 0.01 level as indicated by the p-value < 0.00005. Thus, the null hypothesis, H_0 : Mean VESG – mean WSG = 0, is rejected. This confirmed the hypothesis that the mean for VESG is greater than the mean for WSG. This means that the students in VESG had a lower level of mathematics anxiety than the students in WSG.

For GSG and WSK, the mean for GSG was greater by a difference of 4.33. The significant test gave the p-value < 0.00005, which means that this difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean GSG – mean WSG = 0, is rejected. This confirmed the hypothesis that the students in GSG have a lower level of mathematics anxiety than the students in WSG.

Motivation to Study Mathematics

Table 4.14 Mean Differences of Motivation to Study Mathematics

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Motivation to study mathematics	0.18	0.931	3.17	0.000	2.99	0.000

In the motivation to study mathematics test, the mean score for VESG was greater than the mean score for GSG by a small difference of 0.18. However, this difference was not significant at 0.05 level as indicated by the p-value = 0.931. Thus, the null hypothesis, H_0 : Mean VESG – mean GSG = 0, cannot be rejected. This means that levels of motivation to study mathematics between these two groups were not significantly different.

For VESG and WSG, the mean for VESG was greater by a difference of 3.17, and this difference was significant at 0.01 level as indicated by the p-value < 0.00005. Thus, the null hypothesis, H_0 : Mean VESG – mean WSG = 0, is rejected. This confirmed the hypothesis that the mean score for VESG is significantly greater than the mean score for WSG. This means that the students in VESG had stronger motivation to study mathematics than the students in WSG.

For GSG and WSG, the mean for GSG was greater by a difference of 2.99. The significant test gave the p-value < 0.00005, which means that the difference was significant at 0.01 level. Therefore, the null hypothesis, H_0: Mean GSG – mean WSG = 0, is rejected. This confirmed the hypothesis that the mean for GSG is greater that the mean for WSG. This means that the students in GSG had stronger motivation to study mathematics than the students in WSG.

Personality and Behavioural Characteristics

Table 4.15 Mean Differences of Personality & Behavioural Characteristics

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Personality and Behavioural characteristics	- 2.03	0.008	0.95	0.345	2.98	0.000

In the personality and behavioural characteristics test, higher scores indicated that the students had a more positive and favourable personality and behavioural characteristics for learning mathematics. The difference in the mean scores between VESG and GSG was - 2.03, and it is significant at 0.01 level as indicated by the p-value = 0.008. This result was unexpected because the researcher expected the students in VESG to have a more positive and favourable personality and behavioural characteristics, and therefore, their mean score should higher than the mean for GSG. The same unexpected result was obtained for means comparison between VESG and WSG. Even though the mean for VESG is greater than the mean for WSG, the difference is very small (0.95) and was not significant at 0.05 level as indicated by the p-value = 0.345. This unexpected result will be further analysed and discussed in chapter 5.

For GSG and WSG, the multiple comparisons test gave an expected result where the mean for GSG was greater than the mean for WSG by a difference of 2.98. The significant test gave the p-value < 0.00005 which means that the difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean GSG – mean WSG = 0, is rejected. The mean for GSG was significantly greater than the mean for WSG. This means that the students in GSG had a more positive and favourable personality and behavioural characteristics than the students in WSG.

Psychological Readiness

Table 4.16 Mean Differences of Psychological Readiness

VARIABLE	VESG - GSG	Sig, test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Psych. readiness	- 3.3	0.210	10.59	0.000	13.89	0.000

For VSEG and GSG, the difference in the means was - 3.3. The negative difference was unexpected, but the difference was not significant at 0.05 level, as indicated by the p-value = 0.210. Thus, there was no significant difference in psychological readiness between these two groups.

For VESG and WSG, the mean for VESG was greater than the mean for WSG by a difference of 10.59. The significant test gave the p-value < .00005, which means that the difference was significant at 0.01 level. This showed that the students in VESG had a higher level of psychological readiness towards learning mathematics than the students in WSG.

For GSG and WSG, the mean for GSG was greater than the mean for WSG by a difference of 13.89, and this difference was significant at 0.01 level as indicated by the p-value < 0.00005. This means that the students in GSG had a higher level of psychological readiness towards learning mathematics than the students in WSG.

Cognitive Readiness

Table 4.17 Mean Differences of Cognitive Readiness

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Cognitive readiness	0.89	0.016	4.11	0.000	3.22	0.000

In the cognitive readiness test, the mean for VESG was greater than the mean for GSG by a difference of 0.89. The difference was small, but it was positive and also significant at 0.05 level, as indicated by the p-value = 0.016. Thus, the null hypothesis, H_0 : Mean VESG – mean GSG = 0, is rejected. This result confirmed the hypothesis that the mean for VESG is significantly greater than the mean for GSG. This means that the students in VESG had a higher level cognitive readiness towards learning mathematics than the students in GSG.

For VESG and WSG, the mean for VESG was greater by a difference of 4.11. The significant test gave the p-value < 0.00005, which means that the difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean VESG – mean WSG = 0, is rejected. The mean for VESG was greater than the mean for WSG, and this means that the students in VESG had a higher level cognitive readiness than the students in WSG.

For GSG and WSG, the mean for GSG was greater by a difference of 3.22. The significant test gave the p-value < 0.00005, which means that the difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean GSG – mean WSG = 0, is rejected. This confirmed the hypothesis that the mean for GSG is greater than the mean for WSG. The students in GSG had a higher level of cognitive readiness than the students in WSG.

Learning Strategies

Table 4.18 Mean Differences of Learning Strategies

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
Learning strategies	- 1.4	0.040	3.41	0.000	4.81	0.000

In the learning strategies test, the multiple comparison test gave an unexpected result where the mean score for VESG was smaller than the mean for GSG (difference = - 1.4). The significant test gave the p-value = 0.040, which indicated that the difference was significant at 0.05 level. Thus, the null hypothesis, H_0 : Mean VESG – mean GSG = 0, is rejected. The researcher expected a positive mean difference between VESG and GSG because the students in VESG should have a higher degree of orientation towards meaningful learning than the students in GSG. This unexpected result will be analysed and discussed further in chapter 5.

For VESG and WSG, the result was as expected where the mean for VESG was greater than the mean for WSG by a difference of 3.41, and the difference was significant at 0.01 level, as indicated by the p-value < 0.00005. Thus, the null hypothesis, H_0 : Mean VSEG – mean WSG = 0, is rejected. The mean for VESG was significantly greater than the mean for WSG. The result suggested that the students in VESG were more oriented towards meaningful learning than the students in WSG.

For GSG and WSG, the mean for GSG was greater by a difference of 4.81, and the difference was significant at 0.01 level, as indicated by the p-value < 0.00005. Thus, the null hypothesis, H_0 : Mean GSG - mean WSG = 0, is rejected. The mean for GSG was significantly greater than the mean for WSG. This result suggested that the students in GSG were more oriented towards meaningful learning than the students in WSG.

Learning Style: Abstract Conceptualisation (AC)

Table 4.19 Mean Differences of AC Learning Style

VARIABLE	VESG - GSG	Sig. test	VESG - WSG	Sig. test	GSG - WSG	Sig. test
AC Learning style	0.97	0.525	3.69	0.000	2.72	0.007

The mean score for VESG was greater than the mean score for GSG by a difference of 0.97. However, the difference was small, and it was not significant at 0.05 level, as indicated by the p-value = 0.525. Thus, the null hypothesis, H_0 : Mean VESG - mean GSDG = 0, cannot be rejected. There was no significant difference in the degree of orientation towards abstract conceptualisation mode of learning between these two groups.

For VESG and WSG, the mean for VESG was greater than the mean for WSG by a difference of 3.69. The significant test gave the p-value <0.00005, which means that the difference was significant at 0.01 level. Thus, the null hypothesis, H_0 : Mean VESG – mean WSG = 0, is rejected. The mean for VESG was significantly greater than the mean for WSG. The result suggested that the students in VESG have a higher degree of orientation towards abstract conceptualisation mode of learning than the students in WSG.

For GSG and WSG, the mean for GSG was greater by a difference of 2.72, and it was significant at 0.01 level, as indicated by the p-value = 0.007. Thus, the null hypotheis, H_0 : Mean GSG – mean WSG = 0, is rejected. The mean for GSG was significantly greater than the mean for WSG. This result suggested that the students in GSG had a higher degree of orientation towards abstract conceptualisation mode of learning than the students inWSG.

4.4.3 Results of Multiple Regression Analysis

For multiple regression analysis, these four independent variables -- attitudes towards mathematics, mathematics anxiety, motivation to study mathematics, and personality and behavioural characteristics -- were grouped together under one variable, psychological readiness. The score for psychological readiness was the sum of the scores of these four variables. The other three independent variables were learning strategies, cognitive readiness, and abstract conceptualisation learning style. Thus, there were four independent variables:

(i) Psychological readiness

(ii) Learning strategies

(iii) Cognitive readiness

(iv) Abstract conceptualisation learning style

The dependent variable for the multiple regression analysis was SAM (Students achievements in mathematics). SAM were determined by calculating the mean of the scores that the students got for mathematics and additional mathematics in the Trial SPM 1999 examination. Thus, the predicted variable, SAM, is the mathematics score that the student will get.

The detailed analysis is given the appendix. This section only discusses the results of the analysis. The summary of the results of the multiple regression analysis is shown in table 4.20.

Table 4.20 Results of Multiple Regression Analysis

VARIABLE	COEFFICIENT	SIG. TEST
PSYCHOLOGICAL READINESS	0.238	0.002
COGNITIVE READINESS	3.411	0.000
LEARNING STRATEGIES	0.768	0.003
ABSTRACT CONCEPTUALISATION	0.621	0.000
CONSTANT	- 56.256	0.000

PREDICTION EQUATION FOR SAM :

SAM = 0.238 (PSYCHOLOGICAL READINESS)
+ 3.411 (COGNITIVE READINESS)
+ 0.768 (LEARNING STRATEGIES)
+ 0.621 (ABSTRACT CONCEPTUALISATION)
- 56.256

Note: 0.000 is a rounded figure for p-value < 0.00005

The multiple regression analysis gave the coefficient of 0.238 for psychological readiness, 3.411 for cognitive readiness, 0.768 for learning strategies, 0.621 for abstract conceptualisation learning style, and - 56.256 for the constant. The significant test gave all the p-values < 0.01, which means that all the coefficients were significant at 0.01 level. Thus, all the null hypotheses which state that the regression coefficients equal 0, are rejected. The multiple regression analysis gave the prediction equation for determining SAM (mathematics score) from the scores of the four independent variables as:

$$\text{SAM} = 0.238\,(\text{Psychological readiness}) + 3.411\,(\text{Cognitive readiness}) + 0.768\,(\text{Learning strategies}) + 0.621\,(\text{AC}) - 56.256$$

Based on the scores that a student gets for psychological readiness test, cognitive readiness test, learning strategies test, and learning style test (for abstract conceptualisation), we can predict the score that he/she will get for mathematics, by using the above prediction equation.

CHAPTER 5

DISCUSSION OF RESEARCH FINDINGS

5.1 Attitudes Towards Mathematics

SAM and attitudes towards mathematics were positively related. The correlation test gave the correlation coefficient of 0.479, and it was significant at 0.01 level. Students who had higher scores in mathematics scored higher in the attitudes towards mathematics test. Higher scores in attitudes test indicated a more positive attitude towards mathematics. Thus, students' achievements in mathematics depended on the attitudes that they had towards the subject. Students with positive attitudes towards mathematics scored higher marks in the subject.

This finding concluded that mathematics achievements and attitudes towards mathematics were positively and significantly correlated. Studies which investigated the relationship between mathematics achievements and attitudes towards mathematics by Cheung (1988) in Hong Kong, and Kreangsak Prowsri and Dr. Prapon Jearakul (1986) in Thailand, have obtained similar result. Attitude towards mathematics is, therefore, an important factor which determines the level of achievements in the subject. In order to raise students' achievements in mathematics, efforts must be made in fostering positive and favourable attitudes towards the subject.

In fostering positive attitudes, the three aspects of attitudes — cognitive, affective, and conative – must be attended to. In the cognitive aspect, students need to have positive beliefs about the subject. They need to have the beliefs that mathematics is important in daily life, mathematics is an interesting subject, and it is not a difficult subject to learn. In the affective aspect, they need to foster positive feelings towards the subject. They need to foster the feelings that they like mathematics, and they enjoy and feel happy learning the subject. In the conative aspect, they need to foster positive behaviours towards mathematics. To achieve this, efforts must be made so that they enjoy doing mathematics. Activities, which involve routine mathematical exercises or solving challenging mathematical problems, must be seen as a rewarding, worthwhile and enjoyable experience which the students always look forward to.

In the inter-groups comparisons, the results of the multiple comparison tests showed that there was no significant difference in the means for VESG and GSG. This can be due to the fact that all students in these two groups scored grade A for mathematics in PMR examination (which is a requirement for entrance into any Maktab rendah Sains MARA). Furthermore, VESG and GSG were selected students, and all of them were aware of the importance of mathematics for their further studies in the fields related to science and mathematics. They were also aware that they need to have good grades in mathematics in order to be selected for further studies. Through this awareness, they developed almost similar positive attitudes towards mathematics. Thus, the difference in the attitudes towards mathematics between these two groups was not significant.

The means for VESG and GSG were both significantly greater than the mean for WSG. The students in VESG and GSG had more positive attitudes towards mathematics than the students in WSG. This finding concluded that students, who had very excellent and good achievements in mathematics, had more positive attitudes towards mathematics than the students who had low achievements in the subject. Thus, efforts must be made to foster more favourable attitudes towards mathematics among the weak students in order to help them perform better in the subject.

5.2 Mathematics Anxiety

SAM and scores in the mathematics anxiety test were positively related. The correlation test gave the coefficient of 0.342, and it was significant at 0.01 level. In the mathematics anxiety test, the questionnaires were constructed so that higher scores would indicate a lower level of mathematics anxiety. Thus, higher achievements in mathematics are associated with lower levels of mathematics anxiety. The negative influence of mathematics anxiety on mathematics achievements has been found by many researchers in this field. Studies which investigated the relationship between mathematics anxiety and achievements in mathematics by Hembree(1990), and Suinn (1972) had found similar result.

This finding is consistent with the general view that anxiety interferes with learning and with the ability to understand the learning material. Mathematics anxiety causes interference in conceptual thinking and memory processes (Skemp, 1986). Thus, this finding suggested that mathematics anxiety must be reduced to a comfortable level in order to facilitate learning and help raise the students' achievements in mathematics. High level of mathematics anxiety can lead to fear and avoidance of mathematics (Hembree, 1990). Efforts must be made to help students overcome mathematics anxiety. Teachers can play the role by reducing the tensed and anxious feeling during mathematics classes. Create activities so that learning becomes enjoyable, and students look forward to coming to mathematics classes.

In the inter-groups comparison, the mean for VESG was smaller than the mean for GSG, which indicated that the students in VESG had higher mathematics anxiety than the students in GSG, which was the opposite of what the researcher expected. The reason these VESG students were more anxious was probably because they were aware that they were in one of the best three Maktab Rendah Sains MARA in the country. Furthermore, their teachers always demanded that they produced high grades in mathematics. However, the significant test showed that the difference was not significant (p-value = 0.113). This was consistent with the fact that, for mathematics, students in these two groups did not differ much in their ability. All of them scored grade A for mathematics in PMR examination.

The differences in means for VESG – WSG and GSG – WSG were 2.89 and 4.33 respectively, and the differences were significant at 0.01 level. The conclusion from this finding is the students in VESG and GSG have a lower level of mathematics anxiety than the students in WSG. Weak students, who have low achievements in mathematics, have a high level of mathematics anxiety. To help these weak students perform better in mathematics, efforts must be made in reducing the level of their mathematics anxiety.

5.3 Motivation to Study Mathematics

SAM and motivation to study mathematics were positively related. The correlation test gave the coefficient of 0.342, and it was significant at 0.01 level. This finding gave the conclusion that students with stronger motivation achieved higher scores in mathematics. This finding is consistent with the results obtained by researchers who have conducted studies involving achievement and motivation. Pintrich & Schunck (1996) and Wang, Hartel, & Walberg (1993) found similar result: Motivation and achievement are positively correlated. This is because highly motivated students are always eager to learn, give more effort, and persist in the face of difficulty (Stipek, 1996). Motivation is a force which energises and directs students towards achieving academic excellence.

Students' achievements in mathematics can be raised by giving regular talks, activities and programs aimed at enhancing their motivation to study mathematics. Students who are highly motivated to study mathematics can be characterised as follows:

1. They have strong commitment to achieve excellent grade in mathematics.
2. They enjoy performing challenging tasks.
3. They like doing work involving figures, computation, and abstract objects.
4. They find enjoyment and satisfaction when they succeed in solving mathematical problems.
5. They like challenging learning activities such as solving difficult mathematical problems.
6. They like to compete with other students in achieving excellence.
7. They are hardworking and persistent.
8. They believe that through effort and hard-work, they can achieve high grades in mathematics.

In the inter-groups comparison, the multiple comparison tests showed that there was no significant difference in the level of motivation between VESG and GSG. The mean difference was 0.18, but it was not significant at 0.05 level (p-value = 0.931). For VESG and WSG, the result showed that VESG had a stronger motivation than WSG. The mean difference was 3.17, and it was significant at 0.01 level (p-value < 0.00005). For GSG and WSG, the mean difference was

2.99, and it was significant at 0.01 level (p-value < 0.00005). GSG had stronger motivation than WSG. This shows that students who have low achievements in mathematics are characterised by low level of motivation to study mathematics. Efforts must be made to raise the level of motivation of these weak students in order to improve their performance in mathematics.

5.4 Personality and Behavioural Characteristics

SAM and the scores for the personality and behavioural characteristics test were positively correlated. Although the correlation was quite low (0.137), it was significant at 0.05 level (p-value = 0.018). The result shows that students with higher achievements in mathematics have a more positive personality and behavioural characteristics. These positive personality and behavioural characteristics are:

1. Do not procrastinate, and always finish homework on time.
2. Always be at pace with teacher, and do not get left behind.
3. Having my own orderly study time table.
4. Do not feel shy to ask when do not understand.
5. Like to ask and discuss with friends when doing mathematics.
6. Do work carefully, and not hurriedly.
7. Like to think logically, rationally, and deeply when doing something.
8. Calm and honest.

9. Do not act according to emotions.

10. Do not behave against school rules.

In the inter-groups comparison, the multiple comparison tests gave an unexpected result. The mean difference between VESG and GSG was - 2.03, and it was significant at 0.01 level (p-value = 0.008). The researcher expected to get a positive difference to indicate that VESG have a more positive personality and behavioural characteristics than GSG. However, the result indicated the opposite. For VESG – WSG, the difference was 0.95, but it was not significant at 0.05 level (p-value = 0.345). The researcher expected to get a bigger number for the difference, and the difference to be significant. Only for the GSG – WSG, the test gave the expected result where the difference was 2.98, and it was significant at 0.01 level (p-value < 0.00005). This means that students in GSG had a more positive personality and behavioural characteristics than the students in WSG.

In order to understand the unexpected results for VESG versus GSG, and VESG versus WSG, the researcher analysed all the questionnaires in the personality and behavioural characteristics test. The detailed analysis can be seen in appendix. The summary of the result is given in table 5.1.

Table 5.1 gives the mean scores of the three groups for all the ten questionnaires in personality and behavioural characteristics test. Questionnaire number 4 gives the most unexpected mean scores for the three groups. The mean score for VESG, GSG and WSG respectively were 2.88, 3.44 and 3.27. The mean score for

VESG was the lowest of the three. Questionnaire number 4 was: I have my own orderly study time table.

Excellent students were expected to have their own orderly study time table, and they should choose response number 4 (agree) or 5 (strongly agree) to this questionnaire. Weak students were not expected to have their own study time table. However, the mean scores indicated that the opposite was true. The reason for this is probably because students in VESG have everything planned and arranged for them by their teachers. Residential schools usually prepare fixed schedules for their students. After the formal class hours, the times for meal, study, play and sleep have already been fixed by the school. The students have to follow these schedules. Thus, these students do not have to plan their own study time table. Their teachers have already decided and instructed them what and when to study. All they need to do is follow these instructions and the study time table that has been planned for them. Furthermore, the teachers demand that they follow the study time table. May be, this is why the students in VESG respond negatively to this questionnaire.

The students in WSG were in a different situation. After the formal school hours (usually from 7.30 in the morning to 2.30 in the afternoon), these students were free to do what they like. They had to decide for themselves what and when to study after the formal school hours and during the two-day weekends. Therefore, these students had to plan and prepare their own study time table.

As for the difference between VESG and GSG, except for item number 10, the mean scores of all the items for GSG are greater than the mean scores for VESG. These figures showed that GSG had a more positive personality and behavioural characteristics than VESG. This unexpected result can be explained if we look carefully at the psychological nature or characteristics of the students in VESG. They were the top selected students. Academically, they were high achievers. They had achieved the best grades in the past, and they were strongly committed towards achieving the highest grades in their SPM examination. They strive for excellence, and demand the best from themselves. In whatever they are doing, perfection is what they strive for.

These high achievers are usually critical of themselves, of their feelings and actions. They set high standards for themselves. Thus, when making self-evaluation, they tend to under rate themselves. They believe that they have not yet performed up to the high standards that they have set for themselves. This is probably the reason why the students in VESG score lower in the personality and behavioural characteristics test than the students in GSG.

Table 5.1 Personality and Behavioural Characteristics Test: Mean Scores of VESG, GSG and WSG for all items in the test

Item	Mean VESG	Mean GSG	Mean WSG
No. 1	3.69	3.70	3.30
No. 2	3.47	3.54	3.10
No. 3	4.11	4.23	3.90
No. 4	2.88	3.44	3.27
No. 5	3.94	4.30	3.86
No. 6	4.30	4.39	4.26
No. 7	3.95	4.13	3.86
No. 8	4.04	4.20	3.75
No. 9	3.89	4.09	3.77
No. 10	1.99	1.60	1.47

5.5 Psychological Readiness

The scores for psychological readiness were obtained by taking the sum of the scores for attitudes towards mathematics test, mathematics anxiety test, motivation to study mathematics test, and personality and behavioural characteristics test. Psychological readiness and SAM were positively related.

The correlation coefficient was 0.404, and it was significant at 0.01 level (p-value < 0.00005). The finding showed that students with higher achievements in mathematics were more psychologically ready to learn the subject. Thus, promoting psychological readiness towards mathematics will enhance mathematics achievements.

For inter-groups comparison, the finding shows that there is no significant difference in the level of psychological readiness between VESG and GSG. The mean difference is -3.3, but the difference is not significant at 0.05 level (p-value = 0.210). However, the finding shows that VESG and GSG are significantly different from WSG im term of psychological readiness. The mean difference between VESG and WSG, and GSG and WSG are 10.59 and 13.89 respectively. Both differences are significant at 0.01 level (p-value < 0.00005). VESG and GSG have a higher level of psychological readiness to learn mathematics than GSG. This finding concludes that mathematics achievements of weak students can be improved by enhancing their psychological readiness to learn the subject.

5.6 Cognitive Readiness

The finding showed that SAM and cognitive readiness were positively related. The correlation coefficient was 0.557, and it was significant at 0.01 level (p-value < 0.00005). Cognitive readiness influences mathematics achievements.

Students with a higher level of cognitive readiness scored higher in mathematics. Thus, cognitive readiness is an important factor which influences mathematics achievement. Students must be cognitively ready in order to succeed in learning mathematics.

Results from the multiple comparison tests gave the same conclusion. Students in VESG had a higher level of cognitive readiness than the students in GSG and WSG. The students in GSG had a higher level of cognitive readiness than the students in WSG. Very excellent students were characterised by a high level of cognitive readiness, whereas the weak students were not quite cognitively ready to learn mathematics. Weak students must improve their abilities in abstract reasoning, logical thinking and numerical computation in order to perform better in mathematics. The nature of mathematical knowledge is abstract and conceptual. To understand mathematics lessons, students must be able to think logically and abstractly. Mathematics learning activities usually involve a lot of numerical computations. These are the three aspects of cognitive readiness which are lacking in the weak students. Improving these three aspects of cognitive readiness will lead to higher achievements in mathematics. Thus, in designing programs to help weak students perform better in mathematics, teachers should focus on these three aspects of cognitive readiness.

5.7 Learning Strategies

The finding showed that learning strategies and SAM were positively related. The correlation coefficient was 0.421, and it was significant at 0.01 level (p-value < 0.00005). The students' learning strategies can range from the crude method of rote-memorising to the more sophisticated method of meaningful learning. Students with higher achievements in mathematics scored higher in the learning strategies test, which indicated that these students' learning strategies were oriented towards meaningful learning. High achievement in mathematics requires students to use meaningful learning approaches. Meaningful learning involves the construction of meaning and deep processing of the learning material.

In the inter-groups comparison, the multiple comparison tests showed that the mean for VESG and GSG were significantly greater that the mean for WSG. This means that students in VESG and GSG were more oriented towards meaningful learning approaches when compared to the students in WSG. Weak students were more oriented towards rote-memorising and recall approaches in learning mathematics. Memorise and recall approaches will, undoubtedly, lead to low achievements in mathematics because mathematics requires more than just the ability to memorise and recall the facts, procedures and formulas. Mathematics learning activities are mainly problem solving which involves doing numerical computation. In performing problem solving activities, students need to not only remember the procedures and formulas, but, they need to understand the logical processes behind these procedures and formulas so that they can use them correctly under different situations.

For VESG and GSG, the multiple comparison test gave an unexpected result of the mean for GSG being greater than the mean for VESG. However, the difference (- 1.4) was very small. This unexpected result was, probably, due to the fact that these very excellent students were under great pressure to achieve high grades in mathematics as demanded by their teachers. They, themselves, also set high target. Under such intense pressure put on them, these high achievers may, at times, resort to rote-memorising in order to achieve the high grades.

5.8 Learning Styles

SAM were positively and significantly correlated with abstract conceptualisation (AC) and active experimentation (AE) modes of learning. Students with higher scores in mathematics were more oriented towards abstract conceptualisation as opposed to concrete experience mode of learning. This finding is consistent with the fact that mathematics is abstract and conceptual in nature. AC mode of learning focuses on abstract ideas and concepts, and it stresses on logical reasoning. AC learners think and reason logically. They are good at manipulation of abstract symbols, quantitative analysis, analysing abstract concepts and ideas. These are the characteristics that suit the learning of mathematics. This finding confirmed that AC and mathematics achievements were positively related.

The positive relationship between AE and mathematics achievements was not as expected by the researcher. The researcher expected mathematics achievements to be positively related with reflective observation (RO) mode of learning because the abstract nature of mathematics would require students to use reflection in order to understand the mathematical ideas and concepts. However, after considering the process of learning mathematics in the classroom, the positive relationship between mathematics achievements and AE is acceptable. In order to achieve high scores in mathematics, students have to be active and not just reflective or passive. Students must do lots of mathematics exercises, and solve mathematical problems. Furthermore, in order to understand, they must be active, ask questions and take part in discussions. Being just reflective and observant are not sufficient to succeed in learning mathematics.

Since SAM were positively related with AC and AE, high achievers in mathematics were expected to be in third quadrant of the Kolb's learning style grid. In the third quadrant, learners are called convergers. Thus high achevers in mathematics are convergers. By calculating the scores of AE – RO and AC – CE, and plotting these values in the Kolb's learning style grid, the learning styles of the students can be determined. The learning styles of the 300 students were determined. The number of students according to their groups, and their learning styles are shown in figure 6.1.

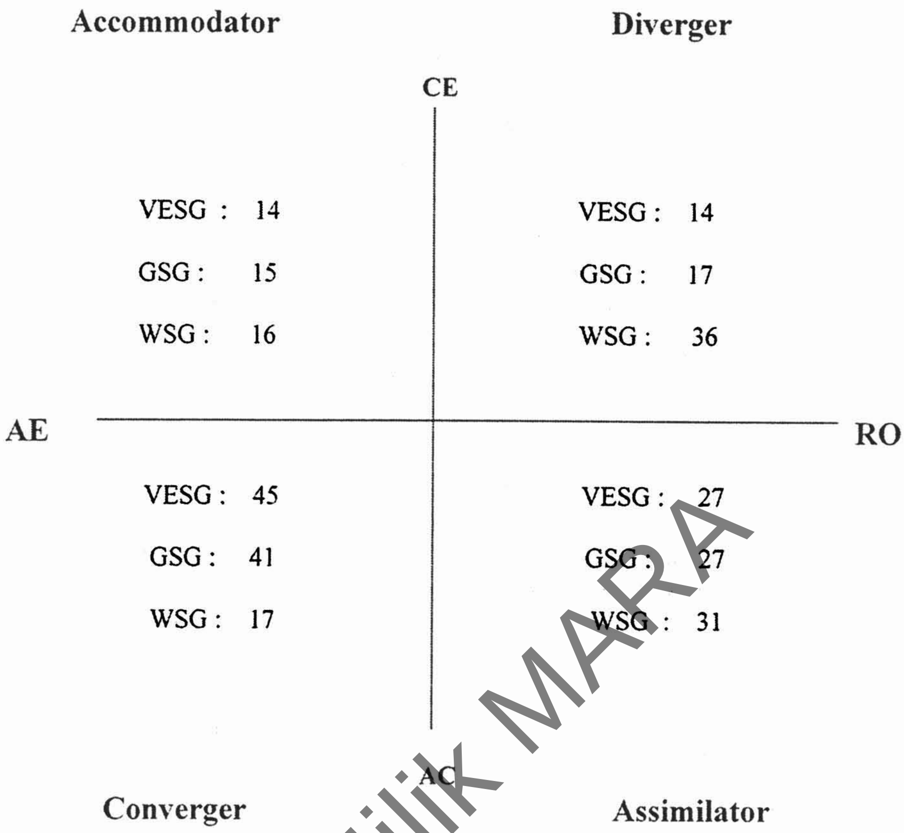


Figure 5.1 Analysis of Students and their Learning Styles

The analysis in figure 5.1 is consistent with the findings of the research. The number of students with AC mode of learning is shown in the third an fourth quadrant.

VESG --- 73 students

GSG --- 68 students

WSG --- 48 students

VESG has the highest number of students with AC mode of learning (73), followed by GSG (68 students). This is consistent with the finding that mathematics achievements are positively related with AC mode of learning. The majority of the students who were oriented towards AC mode of learning were excellent and good students. Research finding has shown that mathematics achievements are associated with convergent learning style. The numbers in the third quadrant are consistent with this finding. The majority of the convergers are students in VESG (45 students) and GSG (41 students). Only 17 students in WSG are convergers. Of the 103 convergers, 86 are students who have high achievements in mathematics

The conclusion from this finding is mathematics achievements can be associated with convergent learning style. Thus, convergent learning style should be promoted in order to raise mathematics achievements. Convergers are learners who prefer active experimentation and abstract conceptualisation as their modes of learning. The characteristics of convergers are:

1. They like abstract ideas and concepts
2. They emphasise thinking, and not feeling.
3. They can think and reason logically.
4. They prefer doing than just observing.
5. They enjoy doing and get things done
6. They are emotionally controlled, analytic, and objectively critical.
7. They are strict disciplinarians.
8. They are highly committed in work
9. They hate inefficiency and confusion.

These are the characteristics which need to be promoted in the students in order to help them perform better in mathematics.

5.9 Multiple Regression

The findings had shown that mathematics achievements were related to the seven independent variables. The purpose of multiple regression analysis was to find an equation which relates mathematics achievements to the seven independent variables. In the multiple regression analysis, these four independent variables – attitudes towards mathematics, mathematics anxiety, motivation to study mathematics and personality and behavioural characteristics – were grouped together as one variable called psychological readiness. The multiple regression analysis gave the following equation for predicting mathematics scores.

Mathematics score = 0.238 (psychological readiness)

+ 3.411 (cognitive readiness)

+ 0.768 (learning strategies)

+ 0. 621 (abstract conceptualisation learning style)

- 56.256

This equation can be used to predict mathematics scores based on the scores of the seven independent variables. This prediction equation can be used for diagnostic purposes. Teachers can ask their students to answer the seven tests for the independent variables. After knowing the scores for the seven variables, teachers can predict the probable mathematics scores of their students. From these predicted scores, weak students can be identified at an early stage so that proper remedial actions can be taken to help these students perform better in mathematics.

This prediction equation can also be used as an entrance test to select students who will perform well in mathematics. The prediction equation, together with the seven instruments, can be used in selecting suitable post PMR students who want to study in Maktab Rendah Sains MARA, or post SPM students who want to further their studies in mathematics related fields. However, these instruments are not suitable for post UPSR students (standard six primary school students) or students in institutions of higher learning because the cognitive readiness test is only suitable for students in age of 15 to 18 years old.

CHAPTER 6

CONCLUSION

6.1 Summary of Research Findings

The purpose of the research was to find the factors within the students, which influenced mathematics achievements among Malay secondary school students in Malaysia. Seven factors had been studied, and the findings had shown that the seven factors correlated significantly with mathematics achievements. The findings suggested that teachers and students need to attend to these factors in order to enhance mathematics achievements. The factors identified in this research were internal factors. They were the internal conditions of the students. Since they were internal conditions, they were within the control of the students. Students should analyse and evaluate their own selves, and determine whether their internal conditions are favourable or not with respect to learning mathematics.

Students must be psychologically and cognitively ready in order to succeed in learning mathematics. The learning of mathematics can be facilitated further through the use of right learning strategies and suitable learning styles. These are the internal aspects of the students, which need to be fostered, in order to facilitate the learning of mathematics. If these internal conditions are negative or unfavourable, students must attempt to change these conditions so that they become positive and favourable. Then, hopefully, improvement in mathematics achievements will occur.

Psychological readiness was an important factor that influenced mathematics achievements. The findings had shown that psychological readiness correlated positively and significantly with mathematics achievements. Weak students were not psychologically ready to learn mathematics. The psychological characteristics of weak students, who have difficulties in learning mathematics, were:

1. They had negative attitudes towards mathematics.
2. Their motivation to study mathematics was low.
3. Their level of mathematics anxiety was high.
4. Their personality and behavioural characteristics were negative and unfavourable for learning mathematics

Positive attitudes towards mathematics will facilitate and enhance the learning of mathematics. Students need to have positive beliefs and feeling for mathematics, and they should behave and act positively when learning and doing mathematics. These were the qualities which were lacking in weak students. They believed that mathematics was not important, was not useful in their lives, and mathematics was a dull and boring subject. They believed that mathematics was a difficult subject to learn. They were not able to understand mathematics lessons. They saw mathematics as a meaningless subject which was detached from reality. Their feeling towards mathematics was that of dislike and hatred. With these negative beliefs and feelings, these students would behave negatively when it came to learning mathematics. They did not pay attention in class, did not do mathematics exercises, and they might even absent themselves from mathematics classes.

These were the conditions in the weak students which needed to be changed in order for them to do well in mathematics. Teachers have to think of activities and programs that will help students develop positive beliefs and feelings towards mathematics. With the proper teaching approaches and interesting learning activities, teachers can help students in developing positive attitudes towards the subject. Improvement in mathematics achievement will occur when positive attitudes are fostered in the students.

Mathematics anxiety had a negative influence on mathematics achievements. Weak students had a high level of mathematics anxiety. They were afraid of mathematics. These students usually experienced the feelings of uneasiness, tension, worry and even fear while in mathematics class. These conditions were not conducive for learning. Efforts must be made to reduce anxiety to a level which facilitates and not inhibits learning. When designing lessons, teachers ought to consider learning activities that will reduce tension and anxiety in the class. Teachers also should assist weak students in getting satisfactory scores in tests. Repeated failures can lead to loss of confidence, and this will raise mathematics anxiety.

Motivation was an important factor which influenced achievements. High achievers were highly motivated students. They had strong commitment, and they persisted in difficult and challenging learning situations. Thus, students must be regularly motivated, either intrinsically or extrinsically, to study mathematics so that they will improve their mathematics achievements.

Positive personality and behavioural characteristics also contributed to high achievements in mathematics. The hierarchical nature of mathematical knowledge required students to be always at pace with their teacher. They must finish homework on time. Procrastination had a great negative influence on mathematics achievements. Personal qualities such as diligence, carefulness, and patience are important when engaging in challenging learning activities such as mathematical problem solving.

Cognitive readiness is crucial in learning mathematics. Upper secondary school mathematics involves a lot abstract ideas and concepts. Topics such as probability, vector, trigonometry, differentiation and integration require a higher level of thinking. Students must have skill in performing complex numerical computations, and have mental capabilities such as abstract reasoning, logical thinking, hypothetical-deductive thinking, and inductive thinking. Students who have not yet fully matured into the formal operational stage of cognitive development will have difficulties in learning these complex and abstract topics. The research finding has confirmed that cognitive readiness is positively and significantly related with mathematics achievements.

Mathematics achievements were in favour of students who were oriented towards meaningful learning strategies as opposed to rote-memorising. Mathematics is obviously not a "remember-and-recall" subject. Students have to understand the ideas and concepts behind the procedures and formulas that they learn in mathematics. Solving mathematical problems requires more than just the application of procedures and formulas that they can get from the text book. Mathematical problem solving involves high order thinking abilities. Thus, mathematics requires meaningful learning strategies. Meaningful learning stresses understanding. In meaningful learning, students construct meaning of what they are learning, and this process involves high order thinking abilities.

As for the learning styles, the research finding had shown that mathematics was in favour of convergent learning style. Convergers are learners who prefer abstract conceptualisation and active experimentation modes of learning. The two modes of learning are consistent with the nature of mathematical knowledge. Mathematics involves a lot of abstract concepts and ideas. Thus, abstract conceptualisation is the right mode of learning for mathematics. To achieve high grades in mathematics, students have to be active by asking questions, taking part in discussions, and doing a lot of exercises.

6.2 Significance of Research for Mathematics Education

Mathematics is an important subject for further studies after the SPM level. Many people relate mathematics achievements with cognitive ability. Thus, high achievers in mathematics were often regarded as intelligent students. Institutions of higher learning also required students to have good grades in mathematics for admission into their various diploma or degree programs. Parents, teachers, and students were aware of the fact that students must have high grades in mathematics if they want to be selected into colleges or universities. The findings of this research had identified factors which influenced mathematics achievements. Thus, this research is significant for mathematics education because the findings give suggestions of what need to be done in order to raise the performance of students in mathematics.

The findings also provided some of the answers to the questions of why many students had difficulties learning mathematics, and failed in mathematics tests. Mathematics educators can refer to the findings, and remedial programs can be taken to overcome these hindering factors so that students will perform better in mathematics. Teachers should focus on these factors, and help their students improve their internal characteristics so that they are more psychologically and cognitively ready for mathematics.

The instruments can be used to identify the factors that hinder students from performing well in mathematics. From students' responses to the questionnaires, teachers can identify the factors that need to be attended to. Scores obtained from these instruments can be put into the multiple regression equation, and the students' mathematics scores can be predicted. The multiple regression equation can be used to select students who have aptitude for mathematics.

6.3 Suggestions for Further Research

The research dealt with only some of the factors that influence mathematics achievements. These factors were the internal conditions or characteristics of the students. They are many other factors that influence mathematics achievements. For example, some people blame the teachers for the poor performance of students in mathematics. The teacher aspect was not considered in this research. Thus, it can be suggested here that a study can be undertaken to investigate how different teaching approaches affect students' performance in mathematics.

The effect of different teaching approaches on attitudes towards mathematics, or mathematics anxiety can be the focus of research. The development of positive or negative attitudes towards the subject can be studied, and this can provide suggestions as to how to promote positive attitudes towards mathematics among students. The school environment and the facilities available in the school can also affect mathematics achievements. This also can be the subject of research.

The personality and behavioural aspects of mathematics teachers, and the teaching methods that they use in classroom are perhaps one of the crucial factors that influence mathematics achievements. Attitudes, mathematics anxiety, motivation and students' learning strategies are very much dependent on teachers' personality and their methods of teaching. A research can be undertaken to find effective teaching methods for mathematics.

Gender differences in mathematics achievements can be another focus of research. The present phenomenon of female students out-performing male students in academic achievements has not yet been fully understood. Various factors that contribute to this phenomenon can be studied. Perhaps, this can be due to the present teaching and learning practices in classroom. The learning situation in classroom that requires students to sit quietly and learn through memorising and doing lots of routine exercises usually suits the personality and behavioural characteristics of female students.

REFERENCES

Aiken, L. R. (1986). 'Attitudes towards mathematics', in Husen, T. and Postlethwaite, T. N. (editors-in-chief), *The International Encyclopaedia of Education,* pp. 4538 –4544.

Ajzen, I. (1988), *Attitudes, Personality and Behaviour.* Open University Press: Milton Keynes.

Allport, G. W. (1935). 'Attitudes' in Murchison, C (ed.). *Handbook of Social Psychology,* Clark University Press: Worcester, pp. 798 – 844.

Anton, W., & Klisch, M. (1995). Perspectives on mathematics anxiety and test anxiety. In C. Spielberger & P. Vagg (Eds.), *Test anxiety: Theory, assessment, and treatment* (pp. 93 – 106). Washington, DC: Taylor & Francis.

Arlin, P. K. (1975). Cognitive development in adulthood: A fifth stage? *Developmental Psychology, 11,* 602 – 606.

Arlin, P. K. (1977). Piagetian operations in problem solving. *Developmental Psychology, 13,* 297 –298.

Atkinson, J. (1980). Motivational effects in so-called tests of ability and educational achievement. In L. Fryans (Ed.), *Achievement motivation: Recent trends in theory and research.* New York: Plenum Press.

Atkinson, J. (1983). *Personality, motivation, and action.* New York: Praeger.

Ausubel, D. P. (1968). *Educational psychology: A cognitive view.* New York: Holt, Rinehart & Winston.

Bandura, A. (1986). *Social foundations of thought and action: Social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1988). Self-efficacy conception of anxiety. *Anxiety Research. An International Journal, 1,* 77 – 98.

Bandura, A. (1995). Exercise of personal and collective self-efficacy in changing societies. In A. Bandura (Ed.), *Self-efficacy in changing societies (pp. 1 – 45).* New York: Cambridge University Press.

Baron, R. (1992). *Psychology (2nd Ed.),* Needham Heights, MA : Allyn & Bacon.

Begle, E. G. (1979). *Critical variables in mathematics education.* Washington, DC: Mathematical Association of America.

Benjamin, M., McKeachie, W., Lin, Y-G., & Holinger, D. (1981). Test anxiety: Deficits in information processing. *Journal of Educational Psychology, 73,* 816 – 824.

Berenson, S. B. (1985). *Using the computer to relate cognitive factors to mathematics achievement.* The Florida State University. DAI, 46A: 2605; Mar. 1986.

Berk, L. (1997). *Child development* (4th ed.). Boston: Allyn & Bacon.

Biggs, J. B. (1979). Individual differences in study processes and the quality of learning outcomes. *Higher Education, 8,* 381 – 394.

Bishop, A. J. (1988). The interactions of mathematics education with culture. *Cultural Dynamics, 1,* 145 – 157.

Blanck, G. (1990). Vygotsky: The man and his cause. In L. C. Moll (Ed)., *Vygotsky and education* (pp. 31 – 58). Cambridge: Cambridge University Press.

Blumenfield, P. (1992). Classroom learning and motivation : Clarifying and expanding goal theory. *Journal of Educational Psychology, 84(3),* 272 – 281.

Brophy, J. & Good, T. (1986). Teacher behaviour and student achievement. In M. Wittrock (Ed.), *Handbook of research on teaching (3rd Ed.)* (pp. 328 – 375). New York : Macmillan.

Brown, D., & Wheatley, G. (1989). Relationship between spatial ability and mathematics knowledge. In C. Maher, G. Goldin, & R. Davis (Eds.), *Proceedings of the Eleventh Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 143 – 148). Rutgers University: New Brunswick, NJ.

Brush, L. (1979). *Why women avoid the study of mathematics: A longitudinal study.* Cambridge, MA: Abt Associates.

Bush, W. S. (1991). Factors related to changes in elementary students' mathematics anxiety. *Focus on Learning Problems in Mathematics.* Volume 13, Number 2.

Carpenter, T., Corbitt, M., Kepner, H., Lindquist, M., & Reys, R. (1981). *Results from the second mathematics assessment of the National Assessment of Educational Progress.* Reston, VA: National Council of Teachers of Mathematics.

Case, R. (1992). *The mind's staircase.* Hillsdale, NJ: Erlbaum.

Cheung, K. C. (1988). Outcomes of schooling: Mathematics achievement and attitudes towards mathematics learning in Hong Kong. *Educational Studies in Mathematics 19 (1988)* , pp. 209-219.

Christie, M. (1985). *Aboriginal Perspectives on Experience and Learning: The Role of Language in Aboriginal Education.* Deakin University Press, Victoria.

Cobb, P. (1990). A constructivist perspective on information-processing theories of mathematical activity. *International Journal of Educational Research, 14(1),* 67 – 92.

Coleman, J. S. ,. (1966). *Equality of educational opportunity*, Washington, DC: US Department of Health, Education and Welfare.

Confrey, J. (1990). A review of the research on student conceptions in mathematics, science, and programming. In C. B. Cazden (Ed.), *Review of Research in Education* (Vol. 1, pp. 3 – 56). Washington, DC: American Educational Research Association.

Covington, M., & Omelich, C. (1987). "I knew it cold before the exam": A test of the anxiety blockage hypothesis. *Journal of Educational Psychology, 79,* 393 – 400.

Deci, E. , & ryan, R. (1987). The support of autonomy and the control of behaviour. *Journal of Personality and Social Psychology, 53,* 1024 – 1037.

De Corte, E. (1995). Designing powerful teaching-learning environments conducive to the acquisition of cognitive skills. In R. Olechowski & G. Khan-Svik (Eds.), *Experimental research on teaching and learning* (pp. 67 – 82). Frankfurt, Germany: Peter Lang.

De Corte,E., Greer, B., & Verschaffel, L. (1996). Mathematics teaching and learning. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 491 – 549). New York: Simon & Schuster Macmillan.

De Lisi, R., & Straudt, J. (1980). Individual differences in college students' performance on formal operational tasks. *Journal of Applied Psychology, 1,* 201 –208.

Dunn, R. (1992). Strategies for teaching word recognition to disabled readers. *Reading and Writing Quarterly Overcoming Learning Difficulties, 8(2),*157 – 177.

Dweck, C., & Goetz, T. (1978). Attributions and learned helplessness. In W. Harvey & R. Kidd (Eds.), *New directions in attribution research* (Vol. 2, pp. 157 – 179). Hillsdale, NJ: Lawrence Erlbaum Associates.

Earley, P., & Lituchy, T. (1991). Delineating goal and efficacy effects: A test of three models. *Journal of Personality and Social Psychology, 25, 109 – 116.*

Encyclopaedia Britannica : Encyclopaedia Britannica Incorporated, 1978.

Entwistle, N. J. (1987). *Understanding Classroom Learning.* London: Hodder & Stoughton.

Everson, H., Tobias, S., Hartman, H., & Gourgey, A. (1993). Test anxiety and the curriculum: The subject matters. *Anxiety, Stress and Coping: An International Journal, 6,* 1 – 8.

Eysenck, H. & Evans, D. (1996). *Test Your Child's Abilities.* London : Harper Collins.

Fennema, E., Franke, M. L. , Carpenter, T. P., & Carey, A. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30,* 555 – 583.

Flavell, J. , Miller, P. , & Muller, S. (1993). *Cognitive development* (3rd ed.). Englewood Cliffs, NJ: Prenrice Hall.

Franklin, M. E. (1992). Culturally sensitive instructional practices for African-American learners with disabilities. *Exceptional Children, 59,* 115 – 122.

Gagne, E., Yekovich, C., & Yekovich, F. (1993). *The cognitive psychology of school learning* (2nd ed.). New York: Harper Collins.

Garger, S., & Guild, P. (1984). Learning styles: The crucial differences. *Curriculum Review, 23* , 9 – 12.

Gay, J., & Cole, M. (1967). *The New Mathematics in an Old Culture: A Study of Learning among the Kpelle of Liberia.* New York: Holt, Rinehart & Winston.

Gesell, A. (1940). *The first five years of life.* New York: Harper & Row.

Good, T., & Brophy, J. (1997). *Looking in the classrooms (7th ed.).* New York: HarperCollins.

Goodlad, J. (1984). *A place called school.* New York: McGraw-Hill.

Gottfried, A. (1985). Academic intrinsic motivation in elementary and junior high students. *Journal of Educational Psychology, 82*, 525 – 538.

Greeno, J. G. (1991). A view of mathematical problem solving in school. In M. U. Smith (Ed.), *Toward a unified theory of problem solving: Views from the content domains* (pp. 68 – 98). Hillsdale, NJ: Lawrence Erlbaum Associates.

Greenwood, J. (1984). My anxieties about math anxiety. *Mathematics teacher, 77,* 662 – 663.

Gremli, J. (1996). Tuned in to learning styles. *Music Educators Journal, 83*, 24 – 27.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education, 21,* 33 – 46.

Holroyd, K., & Appel, M. (1980). Test anxiety and physiological responding. In I. Sarason (Ed.), *Test anxiety: Theory, research, and applications.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Hull, C. L. (1943). *Principles of Behaviour*, New York: Appleton-Century-Crofts.

Inhelder, B., & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence.* (A. parsons & S. Milgram, Trans.). New York: Basic.

Keating, D. P (1979). Adolescent thinking. In J. Adelson (Ed.). *Handbook of adolescent psychology* (pp. 211 – 246). New York: Wiley.

Keating, D. P. (1990). Adolescent thinking. In S. S. Feldman & G. R. Elliott (Eds.), *At the threshold: The developing adolescent* (pp. 54 – 89). Cambridge, MA: Harvard University Press.

Keefe, J. W. (1982). Assessing student learning style: An overview. In *Student Learning Styles and Brain Behaviour*, Reston, VA : National Association of Secondary School Principals.

Kolb, D. A. (1976). *Learning Style Inventory.* Boston : Mc Ber & Co.

Kolb, D. A. (1984). *Experiential Learning : Experience as the Source of Learning and Development.* Englewood Cliff, N. J. : Prentice-Hall, Inc.

Kolb, D. A. (1985). *Learning Style Inventory.* Boston : Mc Ber & Co.

Kreangsak Prowsri & Dr. Prapon Jearakul. (1986). *Journal of Science and Mathematics Education in South East Asia, Vol.: IX, No. 2*, December 1986.

Kimball, M. M. (1989). A new perspective on women's math achievement. *Psychology Bulletin, 105,* 198 – 214.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American Educational Research Journal, 27,* 29 – 63.

Lazarus, M. (1975). Rx for mathophobia. *Saturday Review, 2,* pp. 46 – 48.

Lindvall, C. M., & Cox, R. C. (1970). The role of evaluation in programs for individualised instruction. *The Science Teacher,* Vol. 37, no. 5, 59 – 61.

Lourdusamy, A. (1994). *Perbezaan gaya kognitif individu dan implikasinya terhadap pendidikan.* Syarah Perlantikan Professor Baru, Universiti Sains Malaysia.

Lourdusamy, A., Zainal Datuk Ghani, Gajaraj, D., Peter Choo, P. F., & Lee Ean Kee (1989). *Off-campus adult student characteristics (Malaysia) and their relationship to academic achievement.* University of Sains Malaysia. USM/IDRC Research.

Marton, F., Hounsell, D. J., & Entwistle, N. J. (Eds.). (1984). *The experience of learning.* Edinburgh: Scottish Academic Press.

Marton, F., & Saljo, R. (1976). On qualitative differences in learning – 1: Outcome and process. *British Journal of Educational Psychology, 46,* 4 – 11.

Marton, F., Watkins, D., & Tang, C. (1997). Discontinuities and continuities in the experience of learning: An interview study of high-school students in Hong Kong. *Learning and Instruction, 7,* 21 – 48.

Maslow, A. H. (1968). *Toward a psychology of being (2nd Edition),* New York: Van Nostrand.

Maslow, A. H. (1970). *Motivation and Personality (2nd Edition),* New York : Harper & Row.

Mayer, R. E. (1987). *Educational psychology: A cognitive approach.* Boston: Little, Brown.

Mayer, R. E. (1992). Guiding students' cognitive processing of scientific information. In M. Pressley, K. Harris, & J. Guthrie (Eds.), *Promoting academic competence and literacy: Cognitive research and instructional innovation* (pp. 243 – 258). Orlando, FL: Academic Press.

Mayer, R. E. (1996). Learners as information processors: Legacies and limitations of educational psychology's second metaphor. *Educational Psychologist, 31(4),* 151 – 161.

Mayer, R. E., & Hegarty, M. (1996). The process of understanding mathematical problems. In R. J. Sternberg & T. Ben-Zeev (Eds.), *The nature of mathematical thinking (pp. 29 – 53).* Mahwah, NJ: Erlbaum.

McCombs, B. (1998). Integrating metacognition, affect and motivation in improving teacher education. In N. Lambert & B. McCombs (Eds.), *How students learn: Reforming schools through learner-centered education* (pp. 379 – 408). Washington, DC : American Psychological Association.

McLeod, D. B. (1993). Affective responses to problem solving. *Mathematics Teacher*, 86, 761 –763.

McLeod, D. B. and Adams, V. M. (eds.). (1989). *Affect and Mathematical Problem Solving: A New Perspective*, Springer-Verlag, New York.

Murray, H. A. (1938). *Explorations in Personality*, Oxford University Press. New York.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

Oppenheim, A. N. (1966). *Questionnaire Design and Attitude Measurement*, Heinmann, London.

Owens, D. T., & Super, D. B. (1993). Teaching and learning decimal fractions. In D.T. Owens (Ed.), *Research ideas for the classroom: Middle grades mathematics (pp. 179 – 198).* New York: Macmillan.

Papalia, D., & Wendkos-Olds, S. (1996). *A child's world: Infancy through adolescence* (7th ed.). New York: McGraw-Hill.

Piaget, J. (1932/1965). *The moral judgement of the child.* New York: Free Press. (Original work published 1932)

Piaget, J. (1950). *The psychology of intelligence.* New York: Harcourt, Brace.

Piaget, J. (1952). *Origins of intelligence in children.* New York: International Universities Press.

Piaget, J. (1959). *Language and thought of the child.* (M. Grabain, Trans.). New York: Humanities Press.

Piaget, J. (1970). *The science of education and the psychology of the child.* New York: Orion Press.

Piaget, J. (1980). *Adaptation and intelligence: Organic selection and phenocopy* (S. Eames, Trans.) Chicago: University of Chicago Press.

Piaget, J., & Inhelder, B. (1969) . *The origin of the idea of chance in children.* New York: Norton.

Pintrich, P. & Schunk, D. (1996). *Motivation in education: Theory, research, and applications*. Upper Saddle River, NJ : Prentice Hall.

Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data, *Journal of Counselling Psychology,* 19, 551 – 554.

Romberg, T. A. (1992). Mathematics learning and teaching: What we have learned in ten years. In C. Collins & J. N. Mangieri (Eds.), *Teaching thinking: An agenda for the 21st century.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Sapp, M., Farrell, W., & Durand, H. (1995). The effects of mathematics, reading, and writing tests in producing worry and emotionality test anxiety with economically and educationally disadvantaged college students. *College Student Journal, 29,* 122 – 125.

Sarason, I. G., & Sarason, B. R. (1990). Test anxiety. In H. Leitenberg (Ed.), *Handbook of social and evaluation anxiety (pp. 475 – 495).* New York: Plenum.

Schmeck, R. (1988). *Learning Strategies and Learning Styles*, NY : Plenum Press.

Schoenfeld, A. (1992). On paradigms and methods: What do you do when the ones you know don't do what you want them to? Issues in the analysis of data in the form of videotapes. *Journal of The Learning Sciences, 2.* 179 – 214.

Schunk, D. : 1990, Introduction to the special section on motivation and efficacy, Journal of Educational Psychology, 82, 1 – 6.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26, 207 – 232.*

Schunk, D. & Hanson, A. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology* , *77*, 313 – 322.

Seligman, D. (1975). *Helplessness.* San Francisco: Freeman.

Sepie, A. C., & Keeling, B. (1978). The relationship between types of anxiety under-achievement in mathematics. *Journal of Educational Research, 72,* 15 – 19.

Seligman, D. (1995). *The optimistic child.* Boston: Houghton Mifflin.

Skemp, R. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching, 77*, 20 – 26.

Skemp, R. R. (1986). *The Psychology of Learning Mathematics.* Penguin, Harmondsworth.

Schwartz, B. (1990). The creation and destruction of value. *American Psychologist, 45,* 7 – 15.

Schwarzer, R., & Jerusalem, M. (1992). Advances in anxiety theory: A cognitive process approach. In K. Hagtvet & T. Johnsen (Ed.), *Advances in test anxiety research* (Vol. 7, pp. 2 – 17). Amsterdam: Swets & Zeitlinger.

Scott-Hodgetts, R. (1986). Girls and mathematics: The negative implications of success. In L. Burton (Ed.), *Girls into maths can go* (pp. 61 – 76). New York: Holt, Rinehart, and Winston.

Scott-Hodgetts, R. (1987). Preferred learning strategies and educational/mathematical philosophies: An holistic study. In J. Bergeron, N. Herscovics, & C. Kieran (Eds.), *Proceedings of the Eleventh International Conference of the Psychology of Mathematics Education* (pp. 339 – 345). Montreal: University of Montreal.

Steffe, L. P., Cobb, P., & von Glasersfeld, E. (1988). *Construction of arithmetical meanings and strategies.* New York: Springer.

Stipek, D. (1996). Motivation and instruction. In D. Berliner & R. Calfee (Eds.), *Handbook of Educational Psychology* (pp. 85 – 113). New York: Macmillan.

Stodolsky, S. (1985). Telling math: Origins of math aversion and anxiety. *Educational Psychologist, 20,* 125 – 133.

Tharp, R. G. (1989). Psycho-cultural variables and constants: Effects on teaching and learning in schools. *American Psychologist, 44,* 349 – 359.

Threadgill, J. N. (1979). The relationship of field-independent / dependent cognitive style and two methods of instruction in math learning. *Journal of Research in Mathematics Education, 10(3), 219 – 222.*

Tobias, S. (1992). The impact of test anxiety cognition in school learning. In K. A. Hagtvet & T. B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7). Amsterdam: Swets & Zeitlinger.

Tomlinson-Keasey, C., Eisert, D. C., Kalle, L. R., Hardy-Brown, K., & Keasey, B. (1978). The structure of concrete operational thought. *Child development, 50,* 1153 – 1163.

Topman, R., Kleijn, W., van der Ploeg, H., & Masset, E. (1992). Test anxiety, cognition, study habits and academic performance: A prospective study. In K. Hagtvet & T. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 239 – 259). Amsterdam: Swets & Zeitlinger.

Triandis, H. C. (1971). *Attitude and Attitude Change*, Wiley and Sons Inc., New York.

Von Glasersfield, E. (ed.) (1991). *Radical Constructivism in Mathematics Education,* Kluwer Academic Publishers, Dordrecht, Holland.

Wan Zah bt. Wan Ali (1992). *Deskripsi pembelajaran dari perspektif pelajar.* PhD Disertasi, Fakulti Pendidikan, Universiti Malaya.

Wang, M. , Haertal, G. , & Walberg, H. (1993). Toward a knowledge base for school learning. *Review of Educational Research, 63(3),* 249 – 294.

Weiner, B. (1986). *An attribution theory of motivation and emotion.* New York: Springer-Verlag.

Weiner, B. (1990). History of motivational research in education. *Journal of Educational Psychology, 82,* 616 – 622.

Weiner, B. (1994). Ability versus effort revisited. The moral determinants of achievement evaluation and achievement as a moral system. *Educational Psychologist, 29,* 163 – 172.

Wigfield, A., & Eccles, J. (1994). Children's competence beliefs, achievement values, and general self-esteem: Change across elementary and middle school. *Journal of Early Adolescence, 14,* 107 – 137.

Wigfield, A., Eccles, J., Mac Iver, D., Reuman, D., & Midgley, C. (1991). Transitions during early adolescence: Changes in children's domain-specific self-perception and general self-esteem across the transition to junior high school. *Developmental Psychology, 27,* 552 – 565.

Willcoxson L. & Prosser, M. (1996). Kolb's Learning Style Inventory (1985): Review and further study of validity and reliability. *British Journal of Educational Psychology,* 66, 247 – 257.

Wine, J. (1980). Cognitive-attentional theory of test anxiety. In I. Sarason (Ed.). *Test anxiety: Theory, research and applications* (pp. 349- 384). Hillsdale, NJ: Lawrence Erlbaum Associates.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research, 47,* 1 – 64.

Wittrock, M. C. (1990). Generative processes of comprehension. *Educational Psychologist, 24,* 345 – 376.

Zimmerman, B. (1995). Self-efficacy and educational development. In A. Bandura (Ed.), *Self-efficacy in changing societies (pp. 202 – 231).* Hillsdale, NJ: Erlbaum.

APPENDIX A

ATTITUDES TOWARDS MATHEMATICS TEST

MATHEMATICS ANXIETY TEST

MOTIVATION TO STUDY MATHEMATICS TEST

PERSONALITY AND BEHAVIOURAL CHARACTERISTICS TEST

(BAHASA MELAYU VERSION)

ARAHAN

Soal selidik ini bertujuan mengkaji beberapa perkara yang berkait dengan pembelajaran matematik KBSM dan matematik tambahan di kalangan pelajar-pelajar sekolah menengah. Jawapan yang anda berikan akan menjadi maklumat penting bagi kajian ini.

Sila berikan jawapan secara jujur dan ikhlas. Semua jawapan anda adalah sulit. Soalselidik ini akan dianalisa secara keseluruhan tanpa dikaitkan dengan mana-mana individu tertentu.

Terima kasih diatas kerjasama yang akan anda berikan.

Nama: .... Kelas. ....

ARAHAN: BAGI SOALAN-SOALAN BERIKUT, PADA GARIS JAWAPAN YANG DISEDIAKAN, TULISKAN PILIHAN JAWAPAN ANDA DARI ANGKA 1 HINGGA 5 SEPERTI YANG DITETAPKAN DIBAWAH:

1. Sangat tidak setuju   2. Tidak setuju   3. Tidak pasti

4. Setuju   5. Sangat setuju

Soalan-soalan yang ditanya semuaya merujuk kepada matematik. Matematik yang dimaksudkan disini merangkumi kedua-dua matematik KBSM dan matematik tambahan.

Jawab semua soalan.

SOALAN

JAWAPAN

1. Matematik ialah subjek yang sukar dipelajari. ......
2. Matematik adakah satu subjek yang menarik dan merangsang minda saya......
3. Matematik ialah subjek kesukaan saya. ......
4. Saya rasa seronok dan gembira belajar matematik ......
5. Saya selalu rasa mengantuk dan hilang tumpuan dalam kelas matematik. ......
6. Saya suka menyelesaikan soalan dan masalah matematik yang sukar dan mencabar daya pemikiran saya. ......
7. Saya sentiasa membuat latihan matematik dan menyiapkan kerja rumah matematik yang diberikan oleh guru. ....
8. Jika diberi pilihan, saya tidak mahu belajar matematik. ....
9. Saya rasa gembira dan seronok bila sampai masa untuk kelas matematik. .....

10. Semasa dalam kelas matematik,fikiran dan perasaan saya sentiasa tenang dan tenteram. .....

11. Saya tidak rasa gementar atau takut jika diminta menjawab soalan dalam kelas oleh guru matematik. ......

12. Walaupun kadang-kala sukar difahami, saya tidak takut dengan matematik....

13. Matematik bukanlah antara subjek yang sentiasa menimbulkan perasaan takut, rungsing dan gelisah bagi saya. .....

14. Di antara guru-guru yang mengajar saya, guru matematik adalah antara yang paling saya takuti atau geruni. .....

15. Saya selalu rasa rungsing dan takut dengan ujian matematik. .....

16. Saya rasa sangat tertekan dengan banyaknya latihan dan kerjarumah yang sentiasa diberi oleh guru matematik. .....

17. Saya kerap mengalami ketegangan perasaan, seperti dada berdebar-debar lebih dari biasa, semasa kelas matematik. ......

18. Saya rasa sangat rungsing dan takut dengan matematik, dan ini menyebabkan saya mengenepikan terus subjek ini. .....

19. Saya tidak suka menangguhkan kerja yang diberikan oleh guru. .....

20. Saya sentiasa menyiapkan latihan kerja rumah matematik mengikut masa yang ditetapkan oleh guru. .....

21. Saya sentiasa mengikuti pelajaran matematik yang disampaikan oleh guru dengan teratur supaya tidak ketinggalan dibelakang. .....

22. Saya mempunyai jadual belajar saya sendiri yang teratur. .....

23. Saya tidak segan bertanya guru matematik bila ada sesuatu perkara yang saya tidak faham atau sesuatu soalan yang saya tidak dapat jawab. .....

24. Saya suka bertanya dan berbincang dengan rakan-rakan apabila saya belajar atau membuat latihan matematik. .....

25. Apabila melakukan sesuatu tindakan atau kerja, saya melakukannya secara berhati-hati dan bukan secara gopoh-gapah. .....

26. Sebelum membuat sesuatu, saya suka berfikir secara logikal, rasional, teliti dan mendalam, dan tidak mengikut perasaaan. .....

27. Dari segi perwatakan, saya adalah seorang yang tenang, aman dan boleh dipercayai. .....

28. Saya suka bertindak mengukut perasaan dan banyak melakukan kesalahan-kesalahan yang melanggar peraturan disiplin sekolah. .....

29. Saya mempunyai keazaman yang tinggi untuk mencapai gred yang baik bagi matematik dalam peperiksaan SPM nanti. .....

30. Saya seronok dengan cabaran untuk mendapatkan markah yang tinggi dalam ujian-ujian matematik yang diberikan oleh guru. .....

31. Saya suka membuat kerja yang melibatkan pengiraan, angka dan rajah. .....

32. Kejayaan menyelesaikan sesuatu soalan atau masalah matematik memberi kepuasan kepada saya. .....

33. Saya suka dengan aktiviti pembelajaran yang mencabar keupayaan berfikir dan menyelesaikan masalah seperti yang terdapat dalam matematik. .....

34. Saya tidak takut menghadapi cabaran dan bersaing dengan pelajar-pelajar lain untuk mencapai kecemerlangan. .....

35. Melalui usaha yang gigih, saya boleh mencapai gred yang baik dalam matematik.

36. Hanya sebilangan pelajar yang bijak dan pintar sahaja yang boleh mencapai gred yang baik dalam matematik. .....

37. Saya belajar matematik degan cara menghafal fakta-fakta penting, hukum-hukum, rumus-rumus dan peraturan-peraturan yang terdapat dalam matematik. .....

38. Saya banyak membuat latihan dan latihtubi untuk meningkatkan kebolehan matematik. .....

39. Saya tidak pentingkan kefahaman. Yang penting ialah saya ingat dan dapat menjalankan langkah-langkah penyelesaian, seperti yang diajar oleh guru, agar mendapat jawapan yang betul ......

40. Saya hanya belajar bersungguh-sungguh bila menjelang ujian matamatik. .....

41. Saya berusaha memahami dengan mendalam setiap isi pelajaranmatematik....

42. Saya bertanya guru dan berbincang dengan rakan-rakan untuk mendapatkan pengertian yang mendalam mengenai setiap isi pelalajaran matematik. .....

43. Saya belajar setiap pelajaran matematik dengan teliti dan mendalam sehingga ia menjadi bermakna bagi saya. ......

44. Matematik ialah suatu pelajaran mengenai angka, simbol-simbol, hukum-hukum, rumus-rumus dan pelbagai peraturan yang perlu dihafal dan diingat oleh setiap pelajar. ......

Note: The English language version of these questionnaires can be found in chapter three.

APPENDIX B

COGNITIVE READINESS TEST

(Bahasa Melayu Version)

Nama: .... Sekolah:

..

Arahan: Bagi soalan 1 dan 2, tentukan sama ada kenyataan akhir adalah benar atau palsu.

1. Nordin lebih kecil daripada Hasan. Ramli lebih tinggi daripada Yusuf. Nordin lebih tinggi daripada Ramli. Maka Yusuf lebih tinggi daripada Nordin.

   Jawapan: ....

2. Ramlah dan Burhan lebih tua daripada Harun. Harun lebih muda daripada Lokman. Faridah lebih tua daripada Burhan. Harun lebih tua daripada Latifah. Faridah lebih muda daripada Ramlah. Maka Ramlah lebih tua daripada Burhan dan Lokman lebih tua daripada Latifah.

   Jawapan: ....

Arahan: Bagi soalan 3 dan 4, tuliskan nombor seterusnya pada tempat yang disediakan.

3. 85 91 76 82 (.......)

4. 10 32 16 38 19 (........)

Arahan: Bagi soalan 5, rujuk kepada jadual dibawah, dan tuliskan huruf pada tempat yang disediakan bagi mewakili item seterusnya dalam turutan tersebut.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

5. X L P H L F (……..)

Arahan: Bagi soalan 6, 7 dan lapan, lihat turutan simbol-simbol yang diberi dalam kotak, dan tentukan simbol yang tertinggal. Pilih jawapan dari pilihan yang diberi.

6.

***+	*++	**+++
*++	**+++	***+
**+++	***+	(……..)

A. *+++ B. **+ C. ***++ D. *++

7.

#>>>@@	##>@@@	###>>@
##>@@@	###>>@	#>>>@@
###>>@	#>>>@@	(………..)

A. #>>@@ B. ##>>>@@@ C. ##>@@

D. ##>@@@ E. ###>@@ F. ##>@

8.

a	<g>	<m>	(………)

A. *u* B. <s> C. <u> D. *s*

9. Dalam satu pertandingan kalah mati, terdapat 32 peserta yang mengambil bahagian. Jika setiap peserta bermain sekali setiap pusingan dan yang kalah dikeluarkan daripada pertandingan, berapakah bilangan perlawanan yang perlu dilalui oleh peserta yang akan menjadi juara ?

Arahan: Bagi soalan 10 hingga 13, tuliskan nombor yang tertinggal dalam kurungan yang disediakan.

10.

5	14	16
19	4	12
9	15	(.....)

11.

8	4	36	12
20	12	4	6
14	8	6	18
8	26	4	(.....)

12.

4

(.....) 12

52 20

44 28

36

13.

		12		
	(.....)		18	
2				6
	6		21	
		4		

Arahan: Bagi soalan nombor 14 dan 15, tuliskan nombor dalam kotak yang disediakan.

14.

4 5	9 2	7 3
[3]	[5]	[ ]
6	6	5

15.

7 2	5 9	8 9
[18]	[21]	[ ]
4 5	6 1	4 6

COGNITIVE READINESS TEST

(English Version)

LOGICAL THINKING (2 QUESTIONS)

Instruction: For question 1 and 2, determine whether the final statement is true or false.

1. Nordin is smaller than Hasan. Ramli is taller than Yusof. Nordin is taller than Ramli. Therefore, Yusof is taller than Nordin.

   Answer: True / False

2. Ramlah and Burhan are older than Harun. Harun is younger than Lokman. Faridah is older than Burhan. Harun is older than Latifah. Faridah is younger than Ramlah. Therefore, Ramlah is older than Burhan, and Lokman is older than Latifah.

   Answer: True / False

ABSTRACT REASONING

(i) Recognise and interpret patterns of number sequences (4 questions)

(ii) Recognise and interpret abstract symbols and patterns (4 questions).

Instruction: For questions 3 and 4, write the next number in the place provided.

3. 85 91 76 82 (.......)

4. 10 32 16 38 19 (.......)

Instruction: For questions number 5 and 6, refer to the table below, and write the letter in the place provided to represent the next item in the sequence.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

5. B D E J K (……..)

6. X L P H L F (……..)

Instruction: For questions 7 to 10, look at the sequences of symbols given in the box, and determine the missing symbol. Choose your answer from the given choices.

7.

***+	*++	**+++
*++	**+++	***+
**+++	***+	(…...)

A. *+++ B. **+ C. ***++ D. *++

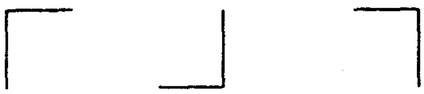
8.

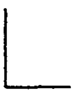
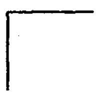
#>>>@@	##>@@@	###>>@
##>@@@	###>>@	#>>>@@
###>>@	#>>>@@	(………..)

A. #>>@@ B. ##>>>@ C. ##>@@

D. ##>@@@ E. ###>@@ F. ##>@

9.

 (………..)

A.  B.  C.  D. 

10.

a	<g>	<m>	(.........)

A. *u* B. <s> C. <u> D. *s*

NUMERICAL AND COMPUTATIONAL ABILITIES (8 QUESTIONS)

11. Jamal walks from the 13^{th} floor to the 42^{nd} floor of an office building. If he can climb one floor every 58 seconds, how long will it take him to reach the 42^{nd} floor?

12. In a knockout competition, there are 32 players taking part. If each player plays one match per round and the loser is eliminated from the competition. how many matches will the winning player have to play?

Instruction: For number 13 to 18, write the missing number in the space provided.

13.

5	14	16
19	4	12
9	15	(......)

14.

8	4	36	12
20	12	4	6
14	8	6	18
8	26	4	(.......)

15. 4

(.....) 12

52 20

44 28

36

16. 12

(.....) 18

2 6

6 21

4

17.

4		5	9		2	7		3
	3			5			[ ]	
	6			6			5	

18.

7		2	5		9	8		9
	18			21			[ ]	
4		5	6		1	4		6

Note: After carrying out reliability analysis, questions number 5, 9 and 11 were found unreliable, and they were eliminated from this instrument.

APPENDIX C

KOLB'S LEARNING STYLE INVENTORY (1985)

(Bahasa Melayu Version)

Nama: …………………………………………. Sekolah: ………………………

Arahan: Inventory gaya pembelajaran ini menghuraikan cara anda belajar dan bagaimana anda bertindak ke atas pendapat dan keadaan harian dalam hidup. Pada tempat yang disediakan (…..), tuliskan angka 1 hingga 4 sebagai jawapan anda. Pilih 1 jika penghujung ayat itu sangat tidak benar mengenai diri anda, dan 4 jika ia sangat benar mengenai diri anda.

1. Apabila saya belajar	saya suka menggunakan perasaan(….)	aya suka elihat dan endengar(….)	saya suka memikir idea-idea(…..)	saya suka melakukan sesuatu kerja(…..)
2. Saya belajar sangat baik apabila	saya percaya pada perasaan dan gerak hati saya(…..)	saya mendengar dan melihat dengan teliti(…..)	saya bergantung kepada pemikiran logik(…..)	saya bekerja kuat menyempurnakan sesuatu kerja(…..)

3. Sewaktu saya sedang belajar	saya mempunyai perasaan dan reaksi yang kuat merasa(.....)	saya seorang pendiam dan sukar berkongsi idea(.....)	saya akan cuba mencari hujah atau alasan(.....)	saya bertanggung-jawab terhadap kerja saya(.....)
4. Saya belajar dengan cara	ikut rasa hati(.....)	memerhati(....)	memikir(.....)	membuat/ melakukan (....)
5. Apabila saya belajar	saya sedia menerima pengalaman baru(.....)	saya mengambil kira semua perkara(.....)	saya suka menganalisis dan memecahkan kepada bahagian-bahagian(....)	saya suka mencuba menyelesai-kan (.....)
6. Sewaktu saya sedang belajar	saya seorang yang intuitif (mengikut gerak hati)(.....)	saya seorang yang memerhati(.....)	saya seorang yang berpemikiran logik(.....)	saya seorang yang aktif(.....)
7. Saya belajar sangat baik dari	perhubungan dengan orang lain(.....)	pemerhatian sendiri(.....)	teori yang rasional(.....)	peluang mencuba dan berlatih(.....)
8. Apabila saya belajar	saya merasa saya terlibat di dalamnya (.....)	saya menunggu seketika sebelum bertindak(.....)	saya suka idea dan teori(.....)	saya suka melihat hasil kerja saya(.....)
9. Saya belajar dengan baik apabila	saya bergantung kepada perasaan (.....)	saya bergantung kepada pemerhatian (.....)	saya bergantung kepada idea(.....)	saya boleh mencuba sesuatu dengan sendiri(.....)

10. Sewaktu saya sedang belajar	saya boleh menerima pandangan orang lain(.....)	saya tidak suka memberi pandangan/ pendapat(.....)	saya seorang yang rasional(.....)	saya seorang yang bertanggung-jawab(.....)
11. Apabila saya belajar	saya melibatkan diri(.....)	saya suka memerhati(.....)	saya suka menilai sesuatu(.....)	saya suka bertindak secara aktif(.....)
12. Saya belajar dengan baik apabila	saya mempunyai fikiran yang terbuka(....)	saya seorang yang teliti(.....)	saya menganalisis idea(.....)	saya seorang yang praktikal(....)

Kolb's Learning Style Inventory (1985)

(English Version)

Instruction: This Learning Style Inventory describes the way you learn and how you deal with ideas and day-to-day situations in your life. In the spaces provided (....), rank the sentence ending with a number from 1 to 4. Rank 1 if the sentence ending seems least like the way you learn, and rank 4 if the sentence describes how you learn best.

	CE	RO	AC	AE
When I learn	I like to deal with my feelings(....)	I like to watch and listen (....)	I like to think about ideas(....)	I like to be doing things(....)

I learn best when	I trust my hunches and feelings(....)	I listen and watch carefully(....)	I rely on logical thinking(....)	I work hard to get things done(....)
When I am learning	I have strong feelings and reactions (....)	I am quiet and reserved (....)	I tend to reason things out (....)	I am responsible about things(...)
I learn by	feeling (....)	Watching (....)	thinking (....)	doing (....)
When I learn	I am open to new experiences (....)	I look at all sides of issues (....)	I like to analyse things, break them into their parts(....)	I like to try things out (....)
When I am learning	I am an intuitive person (....)	I am an observing person (....)	I am a logical person (....)	I am an active person (....)
I learn best from	personal relationships (....)	observation (....)	rational theories (....)	a chance to try out and practice(..)
When I learn	I feel personally involved in things (....)	I take my time before acting (....)	I like ideas and theories (....)	I like to see results from my work (....)
I learn best when	I rely on my feelings (....)	I rely on my observations (....)	I rely on my ideas (....)	I can try things out for myself (....)
When I am learning	I am an accepting person (....)	I am a reserved person (....)	I am a rational person (....)	I am a responsible person(....)

When I learn	I get involved (....)	I like to observe (....)	I evaluate things (....)	I like to be active (....)
I learn best when	I am receptive and open-minded (....)	I am careful (....)	I analyse ideas (....)	I am practical (....)

APPENDIX D

RELIABILITY ANALYSIS: ATTITUDES TOWARDS MATHEMATICS

R E L I A B I L I T Y   A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	ATT2	3.8833	.9405	60.0
2.	ATT3	4.3667	.7357	60.0
3.	ATT4	4.0167	.9296	60.0
4.	ATT5	4.0833	.7431	60.0
5.	ATT6	4.0000	1.0577	60.0
6.	ATT7	3.6333	.9013	60.0
7.	ATT8	3.6333	.8823	60.0
8.	ATT10	4.4667	1.0965	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	32.0833	21.6031	4.6479	8

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ATT2	28.2000	17.7898	.3692	.7817
ATT3	27.7167	17.3590	.6040	.7491
ATT4	28.0667	15.9955	.6379	.7371
ATT5	28.0000	17.1186	.6394	.7440
ATT6	28.0833	15.9082	.5424	.7534
ATT7	28.4500	16.4551	.5929	.7454
ATT8	28.4500	18.6924	.2795	.7937
ATT10	27.6167	17.0540	.3696	.7869

Reliability Coefficients

N of Cases = 60.0   N of Items = 8

Alpha = .7856

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	ATT1	4.7667	.6207	60.0
2.	ATT2	3.8833	.9405	60.0
3.	ATT3	4.3667	.7357	60.0
4.	ATT4	4.0167	.9296	60.0
5.	ATT5	4.0833	.7431	60.0
6.	ATT6	4.0000	1.0577	60.0
7.	ATT7	3.6333	.9013	60.0
8.	ATT8	3.6333	.8823	60.0
9.	ATT9	4.5500	.9099	60.0
10.	ATT10	4.4667	1.0965	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	41.4000	26.4136	5.1394	10

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ATT1	36.6333	24.9480	.1742	.7831
ATT2	37.5167	22.1184	.3856	.7648
ATT3	37.0333	21.6260	.6206	.7387
ATT4	37.3833	20.1726	.6439	.7289
ATT5	37.3167	21.4404	.6424	.7359
ATT6	37.4000	20.7186	.4753	.7531
ATT7	37.7667	20.9277	.5667	.7404
ATT8	37.7667	23.0633	.3035	.7743
ATT9	36.8500	22.9771	.2990	.7754
ATT10	36.9333	21.2836	.3882	.7674

Reliability Coefficients

N of Cases = 60.0   N of Items = 10

Alpha = .7760

APPENDIX E

RELIABILITY ANALYSIS: MATHEMATICS ANXIETY

R E L I A B I L I T Y   A N A L Y S I S - S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	ANX1	3.7333	.7099	60.0
2.	ANX2	3.4000	.9242	60.0
3.	ANX3	3.5000	1.0168	60.0
4.	ANX4	4.1167	.6662	60.0
5.	ANX5	3.8000	1.0218	60.0
6.	ANX6	4.5167	.8924	60.0
7.	ANX7	3.5333	1.1998	60.0
8.	ANX8	3.6333	1.1194	60.0
9.	ANX9	4.2000	1.1320	60.0
10.	ANX10	4.5833	.9441	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	39.0167	31.1353	5.5799	10

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ANX1	35.2833	27.1218	.4747	.7501
ANX2	35.6167	25.7319	.4851	.7452
ANX3	35.5167	25.8133	.4150	.7542
ANX4	34.9000	27.8203	.4086	.7571
ANX5	35.2167	26.8506	.3060	.7690
ANX6	34.5000	27.3051	.3253	.7647
ANX7	35.4833	24.8302	.4069	.7579
ANX8	35.3833	24.2065	.5153	.7398
ANX9	34.8167	24.2201	.5057	.7413
ANX10	34.4333	24.7243	.5879	.7314

Reliability Coefficients

N of Cases =   60.0   N of Items = 10

Alpha =   .7706

APPENDIX F

RELIABILITY ANALYSIS: PERSONALITY AND BEHAVIOUR

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	P1	3.4833	.9654	60.0
2.	P2	3.2167	.8253	60.0
3.	P3	3.9500	.9284	60.0
4.	P4	3.2667	1.0393	60.0
5.	P5	4.1167	.9223	60.0
6.	P6	4.3833	.7612	60.0
7.	P7	4.0167	.7700	60.0
8.	P8	4.0500	.8321	60.0
9.	P9	4.0167	.7917	60.0
10.	P10	4.5833	.7656	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	39.0833	27.7387	5.2668	10

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
P1	35.6000	22.4814	.4725	.7972
P2	35.8667	22.3548	.6026	.7827
P3	35.1333	21.8124	.5840	.7835
P4	35.8167	22.0845	.4682	.7988
P5	34.9667	22.7107	.4752	.7964
P6	34.7000	23.8068	.4513	.7988
P7	35.0667	22.6734	.6099	.7831
P8	35.0333	21.9989	.6467	.7777
P9	35.0667	25.2836	.2296	.8199
P10	34.5000	24.1864	.3939	.8042

Reliability Coefficients

N of Cases =   60.0   N of Items = 10

Alpha =   .8114

APPENDIX G

RELIABILITY ANALYSIS: MOTIVATION TO STUDY MATHEMATICS

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	M1	4.7667	.5326	60.0
2.	M2	4.4167	.6455	60.0
3.	M3	4.0833	.6712	60.0
4.	M4	4.7333	.6069	60.0
5.	M5	4.0500	.7903	60.0
6.	M6	4.0667	.9364	60.0
7.	M7	4.7167	.4903	60.0
8.	M8	4.3500	1.0222	60.0
9.	M9	4.6333	.6630	60.0
10.	M10	3.0500	1.3830	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	42.8667	12.6938	3.5628	10

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
M1	38.1000	10.3288	.6080	.4307
M2	38.4500	10.5568	.4101	.4599
M3	38.7833	10.7828	.3313	.4773
M4	38.1333	11.9480	.0899	.5328
M5	38.8167	9.6099	.5019	.4187
M6	38.8000	9.9254	.3206	.4697
M7	38.1500	10.7737	.5218	.4548
M8	38.5167	10.9997	.0957	.5509
M9	38.2333	12.3514	-.0209	.5586
M10	39.8167	10.9319	-.0165	.6366

Reliability Coefficients

N of Cases = 60.0   N of Items = 10

Alpha = .5283

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	M1	4.7667	.5326	60.0
2.	M2	4.4167	.6455	60.0
3.	M3	4.0833	.6712	60.0
4.	M4	4.7333	.6069	60.0
5.	M5	4.0500	.7903	60.0
6.	M6	4.0667	.9364	60.0
7.	M7	4.7167	.4903	60.0
8.	M8	4.3500	1.0222	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	35.1833	11.3726	3.3723	8

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
M1	30.4167	9.0268	.6444	.6468
M2	30.7667	9.0972	.4774	.6679
M3	31.1000	9.1085	.4476	.6728
M4	30.4500	10.3873	.1577	.7244
M5	31.1333	8.2192	.5581	.6441
M6	31.1167	8.0370	.4631	.6689
M7	30.4667	9.9141	.3945	.6882
M8	30.8333	8.7514	.2606	.7319

Reliability Coefficients

N of Cases =   60.0   N of Items = 8

Alpha =   .7101

APPENDIX H

RELIABILITY ANALYSIS: LEARNING STRATEGIES

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	S1	3.1833	1.2554	60.0
2.	S2	3.9500	.8522	60.0
3.	S3	3.6833	1.4786	60.0
4.	S4	3.3333	1.1885	60.0
5.	S5	2.9000	1.4810	60.0
6.	S6	3.9667	.8629	60.0
7.	S7	3.9500	.9464	60.0
8.	S8	3.7000	.8694	60.0
9.	S9	3.2333	1.4305	60.0
10.	S10	4.4333	.8707	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	36.3333	33.7853	5.8125	10

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
S1	33.1500	27.7907	.3338	.6506
S2	32.3833	29.0540	.4359	.6383
S3	32.6500	25.0788	.4403	.6267
S4	33.0000	27.4915	.3917	.6387
S5	33.4333	30.2497	.0824	.7121
S6	32.3667	28.8802	.4486	.6361
S7	32.3833	28.0031	.4878	.6269
S8	32.6333	29.6938	.3520	.6499
S9	33.1000	25.6508	.4202	.6317
S10	31.9000	31.6847	.1369	.6799

Reliability Coefficients

N of Cases = 60.0   N of Items = 10

Alpha = .6739

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	S1	3.1833	1.2554	60.0
2.	S2	3.9500	.8522	60.0
3.	S3	3.6833	1.4786	60.0
4.	S4	3.3333	1.1885	60.0
5.	S6	3.9667	.8629	60.0
6.	S7	3.9500	.9464	60.0
7.	S8	3.7000	.8694	60.0
8.	S9	3.2333	1.4305	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	29.0000	28.0339	5.2947	8

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
S1	25.8167	22.3895	.3424	.7098
S2	25.0500	23.1669	.5047	.6824
S3	25.3167	20.4573	.4030	.7015
S4	25.6667	22.2599	.3889	.6986
S6	25.0333	23.0497	.5117	.6808
S7	25.0500	22.5229	.5138	.6773
S8	25.3000	23.9085	.3963	.6988
S9	25.7667	20.7921	.3983	.7011

Reliability Coefficients

N of Cases =   60.0   N of Items = 8

Alpha =   .7212

APPENDIX I

RELIABILITY ANALYSIS: COGNITIVE READINESS

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	Q1	.5500	.5017	60.0
2.	Q2	.6000	.4940	60.0
3.	Q3	.3000	.4621	60.0
4.	Q4	.3167	.4691	60.0
5.	Q5	.9667	.1810	60.0
6.	Q6	.7667	.4265	60.0
7.	Q7	.8167	.3902	60.0
8.	Q8	.8500	.3601	60.0
9.	Q9	1.0000	.0000	60.0
10.	Q10	.7667	.4265	60.0
11.	Q11	.6833	.4691	60.0
12.	Q12	.3667	.4860	60.0
13.	Q13	.7167	.4544	60.0
14.	Q14	.7667	.4265	60.0
15.	Q15	.4333	.4997	60.0
16.	Q16	.1500	.3601	60.0
17.	Q17	.5833	.4972	60.0
18.	Q18	.7667	.4265	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	11.4000	7.0237	2.6502	18

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q1	10.8500	6.3331	.1738	.5576
Q2	10.8000	6.1966	.2371	.5452
Q3	11.1000	7.0746	-.1076	.6048
Q4	11.0833	6.4845	.1336	.5642
Q5	10.4333	6.9277	.0664	.5674
Q6	10.6333	6.4395	.1858	.5545
Q7	10.5833	6.4845	.1947	.5531
Q8	10.5500	6.4212	.2591	.5444
Q9	10.4000	7.0237	.0000	.5692
Q10	10.6333	6.7107	.0593	.5750
Q11	10.7167	6.8167	-.0053	.5885
Q12	11.0333	6.2023	.2418	.5443
Q13	10.6833	5.9828	.3754	.5200
Q14	10.6333	6.0328	.3861	.5202
Q15	10.9667	5.7277	.4374	.5039
Q16	11.2500	6.2924	.3331	.5338
Q17	10.8167	5.9489	.3413	.5242
Q18	10.6333	6.5412	.1378	.5624

Reliability Coefficients

N of Cases =   60.0   N of Items = 18

Alpha =   .5672

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	Q1	.5500	.5017	60.0
2.	Q2	.6000	.4940	60.0
3.	Q4	.3167	.4691	60.0
4.	Q5	.9667	.1810	60.0
5.	Q6	.7667	.4265	60.0
6.	Q7	.8167	.3902	60.0
7.	Q8	.8500	.3601	60.0
8.	Q10	.7667	.4265	60.0
9.	Q12	.3667	.4860	60.0
10.	Q13	.7167	.4544	60.0
11.	Q14	.7667	.4265	60.0
12.	Q15	.4333	.4997	60.0
13.	Q16	.1500	.3601	60.0
14.	Q17	.5833	.4972	60.0
15.	Q18	.7667	.4265	60.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	9.4167	6.8573	2.6187	15

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q1	8.8667	6.0158	.2397	.6158
Q2	8.8167	5.8472	.3206	.6011
Q4	9.1000	6.2610	.1603	.6284
Q5	8.4500	6.7602	.0684	.6317
Q6	8.6500	6.1297	.2584	.6121
Q7	8.6000	6.2102	.2545	.6130
Q8	8.5667	6.1480	.3246	.6044
Q10	8.6500	6.6381	.0170	.6477
Q12	9.0500	5.9466	.2846	.6077
Q13	8.7000	5.9763	.3036	.6046
Q14	8.6500	5.9602	.3434	.5989
Q15	8.9833	5.6099	.4215	.5821
Q16	9.2667	6.0972	.3546	.6004
Q17	8.8333	5.8701	.3072	.6036
Q18	8.6500	6.5025	.0795	.6388

Reliability Coefficients

N of Cases = 60.0   N of Items = 15

Alpha = .6297

APPENDIX J

RESULTS OF CORRELATION ANALYSIS

Correlations

		MATHSCOR	ATTITUDE	ANXIETY	PERSONAL
MATHSCOR	Pearson Correlation	1.000	.479**	.342**	.137*
	Sig. (2-tailed)	.	.000	.000	.018
	N	300	300	300	300
ATTITUDE	Pearson Correlation	.479**	1.000	.701**	.486**
	Sig. (2-tailed)	.000	.	.000	.000
	N	300	300	300	300
ANXIETY	Pearson Correlation	.342**	.701**	1.000	.498**
	Sig. (2-tailed)	.000	.000	.	.000
	N	300	300	300	300
PERSONAL	Pearson Correlation	.137*	.486**	.498**	1.000
	Sig. (2-tailed)	.018	.000	.000	.
	N	300	300	300	300
MOTIVATN	Pearson Correlation	.381**	.609**	.511**	.432**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	300	300	300	300
STRATEGY	Pearson Correlation	.421**	.547**	.541**	.427**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	300	300	300	300
ABSNUM	Pearson Correlation	.557**	.273**	.174**	.082
	Sig. (2-tailed)	.000	.000	.003	.159
	N	300	300	300	300
PK	Pearson Correlation	-.298**	-.220**	-.175**	-.010
	Sig. (2-tailed)	.000	.000	.002	.866
	N	300	300	300	300
PR	Pearson Correlation	-.125*	-.147*	-.091	-.154**
	Sig. (2-tailed)	.031	.011	.114	.008
	N	300	300	300	300
KA	Pearson Correlation	.275**	.178**	.145*	-.035
	Sig. (2-tailed)	.000	.002	.012	.551
	N	300	300	300	300
PA	Pearson Correlation	.115*	.156**	.115*	.182**
	Sig. (2-tailed)	.047	.007	.047	.002
	N	300	300	300	300
PSYRDNES	Pearson Correlation	.404**	.857**	.857**	.760**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	300	300	300	300

APPENDIX K

INTER-GROUPS COMPARISONS: ATTITUDES

Oneway

ANOVA

ATTITUDE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	856.820	2	428.410	26.439	.000
Within Groups	4812.500	297	16.204		
Total	5669.320	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: ATTITUDE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.0000E-02	.5693	1.000	-1.3442	1.3242
	3.00	3.5800*	.5693	.000	2.2458	4.9142
2.00	1.00	1.000E-02	.5693	1.000	-1.3242	1.3442
	3.00	3.5900*	.5693	.000	2.2558	4.9242
3.00	1.00	-3.5800*	.5693	.000	-4.9142	-2.2458
	2.00	-3.5900*	.5693	.000	-4.9242	-2.2558

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

ATTITUDE

Tukey HSD[a]

GROUP	N	Subset for alpha = .05	
		1	2
3.00	100	30.2700	
1.00	100		33.8500
2.00	100		33.8600
Sig.		1.000	1.000

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX L

INTER-GROUPS COMPARISONS: MATHEMATICS ANXIETY

Oneway

ANOVA

ANXIETY

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	972.487	2	486.243	18.667	.000
Within Groups	7736.300	297	26.048		
Total	8708.787	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: ANXIETY
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.4400	.7218	.113	-3.1316	.2516
	3.00	2.8900*	.7218	.000	1.1984	4.5816
2.00	1.00	1.4400	.7218	.113	-.2516	3.1316
	3.00	4.3300*	.7218	.000	2.6384	6.0216
3.00	1.00	-2.8900*	.7218	.000	-4.5816	-1.1984
	2.00	-4.3300*	.7218	.000	-6.0216	-2.6384

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

ANXIETY

Tukey HSD[a]

GROUP	N	Subset for alpha = .05	
		1	2
3.00	100	37.1200	
1.00	100		40.0100
2.00	100		41.4500
Sig.		1.000	.113

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX M

INTER-GROUPS COMPARISONS: PERSONALITY AND BEHAVIOURS

Oneway

ANOVA

PERSONAL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	463.460	2	231.730	9.941	.000
Within Groups	6923.260	297	23.311		
Total	7386.720	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PERSONAL
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-2.0300*	.6828	.008	-3.6303	-.4297
	3.00	.9500	.6828	.345	-.6503	2.5503
2.00	1.00	2.0300*	.6828	.008	.4297	3.6303
	3.00	2.9800*	.6828	.000	1.3797	4.5803
3.00	1.00	-.9500	.6828	.345	-2.5503	.6503
	2.00	-2.9800*	.6828	.000	-4.5803	-1.3797

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

PERSONAL

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	Subset for alpha = .05 2
3.00	100	37.4500	
1.00	100	38.4000	
2.00	100		40.4300
Sig.		.345	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX N

INTER-GROUPS COMPARISONS: MOTIVATION

Oneway

ANOVA

MOTIVATN

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	634.047	2	317.023	25.499	.000
Within Groups	3692.500	297	12.433		
Total	4326.547	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: MOTIVATN
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	.1800	.4987	.931	-.9887	1.3487
	3.00	3.1700*	.4987	.000	2.0013	4.3387
2.00	1.00	-.1800	.4987	.931	-1.3487	.9887
	3.00	2.9900*	.4987	.000	1.8213	4.1587
3.00	1.00	-3.1700*	.4987	.000	-4.3387	-2.0013
	2.00	-2.9900*	.4987	.000	-4.1587	-1.8213

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

MOTIVATN

Tukey HSD[a]

GROUP	N	Subset for alpha = .05	
		1	2
3.00	100	33.2600	
2.00	100		36.2500
1.00	100		36.4300
Sig.		1.000	.931

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX O

INTER-GROUPS COMPARISONS: COGNITIVE READINESS

Oneway

ANOVA

ABSNUM

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	935.087	2	467.543	89.686	.000
Within Groups	1548.300	297	5.213		
Total	2483.387	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: ABSNUM
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	2.00	.8900*	.3229	.016	.1332	1.6468
	3.00	4.1100*	.3229	.000	3.3532	4.8668
2.00	1.00	-.8900*	.3229	.016	-1.6468	-.1332
	3.00	3.2200*	.3229	.000	2.4632	3.9768
3.00	1.00	-4.1100*	.3229	.000	-4.8668	-3.3532
	2.00	-3.2200*	.3229	.000	-3.9768	-2.4632

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

ABSNUM

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	2	3
3.00	100	7.1300		
2.00	100		10.3500	
1.00	100			11.2400
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX P

INTER-GROUPS COMPARISONS: LEARNING STRATEGIES

Oneway

ANOVA

STRATEGY

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1224.140	2	612.070	36.878	.000
Within Groups	4929.380	297	16.597		
Total	6153.520	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: STRATEGY
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	2.00	-1.4000*	.5761	.040	-2.7503	-4.97E-02
	3.00	3.4100*	.5761	.000	2.0597	4.7603
2.00	1.00	1.4000*	.5761	.040	4.968E-02	2.7503
	3.00	4.8100*	.5761	.000	3.4597	6.1603
3.00	1.00	-3.4100*	.5761	.000	-4.7603	-2.0597
	2.00	-4.8100*	.5761	.000	-6.1603	-3.4597

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

STRATEGY

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	2	3
3.00	100	26.3000		
1.00	100		29.7100	
2.00	100			31.1100
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX Q

INTER-GROUPS COMPARISONS: PSYCHOLOGICAL READINESS

Oneway

ANOVA

PSYRDNES

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10532.340	2	5266.170	27.497	.000
Within Groups	56881.380	297	191.520		
Total	67413.720	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PSYRDNES
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	2.00	-3.3000	1.9571	.210	-7.8870	1.2870
	3.00	10.5900*	1.9571	.000	6.0030	15.1770
2.00	1.00	3.3000	1.9571	.210	-1.2870	7.8870
	3.00	13.8900*	1.9571	.000	9.3030	18.4770
3.00	1.00	-10.5900*	1.9571	.000	-15.1770	-6.0030
	2.00	-13.8900*	1.9571	.000	-18.4770	-9.3030

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

PSYRDNES

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	2
3.00	100	138.1000	
1.00	100		148.6900
2.00	100		151.9900
Sig.		1.000	.210

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX R

INTER-GROUPS COMPARISONS: CE LEARNING STYLE

Oneway

ANOVA

PK

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	825.927	2	412.963	11.560	.000
Within Groups	10609.860	297	35.723		
Total	11435.787	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PK
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-.5700	.8453	.778	-2.5510	1.4110
	3.00	-3.7700*	.8453	.000	-5.7510	-1.7890
2.00	1.00	.5700	.8453	.778	-1.4110	2.5510
	3.00	-3.2000*	.8453	.000	-5.1810	-1.2190
3.00	1.00	3.7700*	.8453	.000	1.7890	5.7510
	2.00	3.2000*	.8453	.000	1.2190	5.1810

* The mean difference is significant at the .05 level.

Homogeneous Subsets

PK

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	Subset for alpha = .05 2
1.00	100	24.8600	
2.00	100	25.4300	
3.00	100		28.6300
Sig.		.778	1.000

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX S

INTER-GROUPS COMPARISONS: RO LEARNING STYLE

Oneway

ANOVA

PR

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	146.527	2	73.263	2.798	.063
Within Groups	7776.710	297	26.184		
Total	7923.237	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PR
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-.1000	.7237	.990	-1.7960	1.5960
	3.00	-1.5300	.7237	.087	-3.2260	.1660
2.00	1.00	.1000	.7237	.990	-1.5960	1.7960
	3.00	-1.4300	.7237	.118	-3.1260	.2660
3.00	1.00	1.5300	.7237	.087	-.1660	3.2260
	2.00	1.4300	.7237	.118	-.2660	3.1260

Homogeneous Subsets

PR

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1
1.00	100	27.8800
2.00	100	27.9800
3.00	100	29.4100
Sig.		.087

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX T

INTER-GROUPS COMPARISONS: AC LEARNING STYLE

Oneway

ANOVA

KA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	731.847	2	365.923	9.113	.000
Within Groups	11925.390	297	40.153		
Total	12657.237	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: KA
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	2.00	.9700	.8961	.525	-1.1303	3.0703
	3.00	3.6900*	.8961	.000	1.5897	5.7903
2.00	1.00	-.9700	.8961	.525	-3.0703	1.1303
	3.00	2.7200*	.8961	.007	.6197	4.8203
3.00	1.00	-3.6900*	.8961	.000	-5.7903	-1.5897
	2.00	-2.7200*	.8961	.007	-4.8203	-.6197

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

KA

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	2
3.00	100	30.1200	
2.00	100		32.8400
1.00	100		33.8100
Sig.		1.000	.525

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX U

INTER-GROUPS COMPARISONS: AE LEARNING STYLE

Oneway

ANOVA

PA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	248.127	2	124.063	2.838	.060
Within Groups	12985.060	297	43.721		
Total	13233.187	299			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PA
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.5000	.9351	.854	-2.6916	1.6916
	3.00	1.6300	.9351	.189	-.5616	3.8216
2.00	1.00	.5000	.9351	.854	-1.6916	2.6916
	3.00	2.1300	.9351	.059	-6.16E-02	4.3216
3.00	1.00	-1.6300	.9351	.189	-3.8216	.5616
	2.00	-2.1300	.9351	.059	-4.3216	6.160E-02

Homogeneous Subsets

PA

Tukey HSD[a]

GROUP	N	Subset for alpha = .05
		1
3.00	100	31.6200
1.00	100	33.2500
2.00	100	33.7500
Sig.		.059

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 100.000.

APPENDIX V

MULTIPLE REGRESSION ANALYSIS

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	ABSNUM, KA, PSYRDNES, STRATEGY[a]		Enter

a. All requested variables entered.

b. Dependent Variable: MATHSCOR

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.675[a]	.456	.448	15.4837

a. Predictors: (Constant), ABSNUM, KA, PSYRDNES, STRATEGY

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	59203.440	4	14800.860	61.736	.000[a]
	Residual	70724.910	295	239.745		
	Total	129928.35	299			

a. Predictors: (Constant), ABSNUM, KA, PSYRDNES, STRATEGY

b. Dependent Variable: MATHSCOR

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-56.256	9.466		-5.943	.000
	PSYRDNES	.238	.076	.172	3.139	.002
	KA	.621	.141	.194	4.393	.000
	STRATEGY	.768	.256	.167	3.004	.003
	ABSNUM	3.411	.321	.472	10.626	.000

a. Dependent Variable: MATHSCOR

APPENDIX W

ITEMS ANALYSIS FOR PERSONALITY AND BEHAVIOURAL CHARACTERISTICS

Comparing Means

Report

GROUP		PERS.1	PERS.2	PERS.3	PERS.4	PERS.5
1.00	Mean	3.6900	3.4700	4.1100	2.8800	3.9400
	N	100	100	100	100	100
	Std. Deviation	.9067	.8582	.8396	1.0472	.9621
2.00	Mean	3.7000	3.5400	4.2300	3.4400	4.3000
	N	100	100	100	100	100
	Std. Deviation	.9587	.9036	.7635	1.0761	.8587
3.00	Mean	3.3000	3.1000	3.9000	3.2700	3.8600
	N	100	100	100	100	100
	Std. Deviation	.8704	.8348	.9374	.9625	.9103
Total	Mean	3.5633	3.3700	4.0800	3.1967	4.0333
	N	300	300	300	300	300
	Std. Deviation	.9285	.8845	.8579	1.0528	.9283

GROUP		PERS.6	PERS.7	PERS.8	PERS.9	PERS.10
1.00	Mean	4.3000	3.9500	4.0400	3.8900	1.9900
	N	100	100	100	100	100
	Std. Deviation	.7177	.7017	.7095	.7092	.9692
2.00	Mean	4.3900	4.1300	4.2000	4.0900	1.6000
	N	100	100	100	100	100
	Std. Deviation	.7640	.8246	.8040	.8773	.9535
3.00	Mean	4.2600	3.8600	3.7500	3.7700	1.4700
	N	100	100	100	100	100
	Std. Deviation	.8483	.8648	.8689	.9519	.7844
Total	Mean	4.3167	3.9800	3.9967	3.9167	1.6867
	N	300	300	300	300	300
	Std. Deviation	.7779	.8053	.8158	.8596	.9299

BIODATA OF AUTHOR

Che A Halim bin Che Daud was born on 28th of June 1955 in Kampung Raja, Besut, Terengganu. He had his primary education at Sekolah Kebangsaan Kg Raja from 1961 to 1966. From 1967 to 1973, he continued his secondary education at Sekolah Tuanku Abdul Rahman, which is a fully residential school in Ipoh, Perak. In 1974, he was given scholarship by MARA to further his studies at State University of New York at Binghamton, USA. From 1974 to 1978, he studied at the university and obtained his bachelor's degree majoring in mathematics and economics.

In 1978, he started his career as a mathematics teacher at Maktab Rendah Sains MARA, Seremban. In 1983, he obtained his Diploma in Education from University Kebangsaan Malaysia, Bangi. Since 1978, he has been teaching mathematics at Maktab Rendah Sains MARA. From 1985 to 1998, he held the post of the head of mathematics department at Maktab Rendah Sains MARA, Kuala Terengganu. At present, he is an assistant principle (academic affairs) at Maktab Rendah Sains MARA – Yayasan Terengganu, Besut.

Throughout his career as a mathematics teacher, he has been involved in programmes aimed at enhancing the teaching and learning of mathematics. He was particularly intrigued by the problem of why so many students have difficulties in learning mathematics, and this has prompted him to undertake this research. Hopefully, the findings of this research will contribute towards enhancing mathematics education.