RELATIONSHIP BETWEEN PROBLEM SOLVING STYLES AND MATHEMATICS ANXIETY AMONG FORM FOUR SCIENCE STUDENTS

by

Rahmah bt Murshidi

A thesis submitted in partial fulfillment of the requirements for the degree of Master Of Science (Human Resource Development) undertaken at Faculty of Cognitive Science and Human Development UNIVERSITY MALAYSIA SARAWAK

1999
Declaration

In accordance with the regulations for presenting theses and other work for higher degrees, I hereby declare that this thesis is entirely my own work and that it has not been submitted for a degree at any other university.

Rahmah bt Murshidi
DEDICATION

To my dedicated and supportive parents,
Hj Morshidi & Hajah Shahara,

To my beloved, caring and supportive husband,
Saiful Hj Yahya

To my loving children,
Khairul, Haziq, Fatin & Yasmin

To my loving and supportive brothers and sisters
Zainah, Zalia, Sa'odah, Abd. Karim & Abd. Razak

To my respected in-laws
Hj Yahya & Hajah Maimun

For all the patience, unfailing support, understanding, love and care all these while.
ACKNOWLEDGEMENTS

First and foremost all praise and thanksgiving to God Almighty for gracing me with the strength to complete this dissertation in time.

To both my supervisors, Miss Angela Anthonysamy and Mr Hong Kian Sam, I wish to extend my very sincere and deepest appreciation for their patience, guidance, support and encouragement throughout the completion of my dissertation. Without their unfailing support, I could have never completed it.

My deepest gratitude also goes to the Director and the lecturers of IAB, Dean, lecturers and staffs of Faculty of Cognitive Science and Human Development, UNIMAS for their guidance, support and cooperation.

My special word of thanks to my friend Pn Sufiah Hj Su'ut for giving me ideas and assistance in starting my work, my friend, En. Ibrahim Takip, a language expert from MPBL, my sister, Dr. Zalia Morshidi Esslinger and her husband Dr. Hamzah Olivier Esslinger from UK, my mentor Professor Dr. Sulaiman Mohd. Yassin of UPM Trengganu, for giving me some inspiration, input and proof read my work and lastly to my dear friend, Mr David Redman from Nevada, USA for providing me with all the necessary materials, support and assistance that I need.

Last but not least, many thanks to Jabatan Pendidikan Negeri Sarawak, school principals, assistants principals and all the form four science students of the participating schools. I wish to express my appreciation for their cooperation and assistance at the time when I conducted my study.
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ABSTRACT

This study investigated whether there exist a significant correlation between problem solving styles (including problem solving confidence, approach-avoidance style and personal control) and mathematics anxiety. This study also attempted to describe the problem solving styles and mathematics anxiety level of the students. Finally, this study aimed to test whether there exist significance gender differences in problem solving styles and mathematics anxiety. The samples consisted of 204 form four science students from eight secondary schools in Kuching city in Sarawak. The study was conducted in two phases. The first phase involved the selection and preparation of appropriate instruments to measure problem solving styles and mathematics anxiety level. The second phase included the administration of the test, the collection and the analysis of the data to answer the research questions. The findings in general, indicated there was a significant but weak correlation between problem solving styles and mathematics anxiety ($r = 0.23, p < 0.01$). The correlation was also significant between mathematics anxiety and all the three factors in problems solving styles, i.e problem solving confidence ($r = 0.19, p < 0.01$), approach-avoidance style ($r = 0.17, p < 0.05$) and personal control ($r = 0.26, p < 0.01$). The students perceived that they had a combination of positive and negative appraisals in their problem solving abilities. The students also exhibited a low and moderate level of mathematics anxiety. There was no significant gender difference in both problem solving styles ($t = -1.64$) and mathematics anxiety ($t = -0.99$).
Kajian ini meninjau samada wujudnya hubungan yang signifikan antara gaya penyelesaian masalah (termasuk keyakinan menyelesaai masalah, gaya mendekati masalah atau mengelakukan masalah dan pengawalan kendiri) dengan tahap kebimbangan matematik. Kajian ini juga berhasrat untuk menghuraikan gaya penyelesaian masalah dan tahap kebimbangan matematik pelajar. Akhir sekali, kajian ini berhasrat untuk menguji samada wujudnya perbezaan jantina yang signifikan dalam gaya penyelesaian masalah dan tahap kebimbangan matematik. Sampel kajian terdiri daripada 204 pelajar tingkatan empat aliran sains dari lapan buah sekolah menengah di bandaraya Kuching, Sarawak. Kajian ini dilakukan dalam dua fasa. Fasa pertama melibatkan pemilihan dan penyediaan instrumen-instrumen yang bersesuaian untuk mengukur gaya penyelesaian masalah dan tahap kebimbangan matematik. Fasa kedua meliputi pentadbiran ujian, pengumpulan dan penganalisisan data untuk menjawab soalan-soalan kajian. Dapatan kajian secara umum menunjukkan terdapat hubungan yang signifikan tetapi lemah antara gaya penyelesaian masalah dan kebimbangan matematik \( r = 0.23, p < 0.01 \). Hubungan juga signifikan di antara kebimbangan matematik dan kesemua tiga faktor dalam gaya penyelesaian masalah ia itu keyakinan menyelesaai masalah \( r = 0.19, p < 0.01 \), gaya mendekati masalah atau mengelakukan masalah \( r = 0.17, p < 0.05 \) dan pengawalan kendiri \( r = 0.26, p <0.01 \). Pelajar mempunyai gabungan tanggapan positif dan negatif tentang kebolehan mereka menyelesaikan masalah. Pelajar juga mempamerkan tahap kebimbangan matematik yang rendah dan sederhana. Tidak terdapat perbezaan jantina yang signifikan dalam kedua-dua gaya penyelesaian masalah \( t = -1.64 \) dan tahap kebimbangan matematik \( t= -0.99 \).
1.0 Introduction
Malaysia aspires to become a fully developed and industrialized nation by the year 2020. All efforts are fully channeled by the government to establish a scientific and progressive society as envisioned by the sixth challenge in Malaysian's vision 2020. The aim is to develop a society which acts as a contributor to the scientific and technological civilization of the future instead of a mere consumer or an end-user of technology (Vision 2020, 1997).

In order to attain this vision, our education system needs to produce knowledge workers with a sufficiently high literacy in mathematics. Knowledge workers are workers who create, modify and synthesize knowledge (Reich, 1991, as cited in Taylor, 1998). To become knowledge workers, the acquisition of problem solving skills, scientific and technological literacy as thinking tools are essential (The Commission on Pre-College Education in Mathematics, Science and Technology, 1983, as cited in Boser, 1993). Literacy in mathematics is a must in this context as it is the language of science and technology (National Research Council, 1989) and the foundation for democracy in the technological age. Besides, industries expect school graduates to be able to use wide varieties of mathematical methods to solve problems when they join the workforce (Mathematical Science Educational Board, 1993).

To have a sufficiently high literacy in mathematics, students need to have high mathematics performance and high mathematics achievement. Research on mathematics anxiety and achievement has showed that high mathematics achievement is related to low mathematics anxiety and vice versa for students from elementary school to college (e.g., Betz, 1978; Clute, 1984; Foong, 1984; Satake and Amato, 1995; Swetman, Munday, & Windham, 1993 as cited in Teo, 1997). Hence, it is crucial to alleviate mathematics anxiety so that achievements in mathematics can be improved. Producing high mathematics achievers with low mathematics anxiety seems to be a crucial task and responsibility of the schools. The success of the nation's effort in realizing vision 2020 will largely depend on the ability of Malaysian schools to educate young Malaysians and groom them into the required knowledge workers. These knowledge workers are the basis of the nation's advanced workforce in science and technology.

1.1 Background of the study.
In order to meet the demand for knowledge workers in the industrialized, technological and scientific nation of vision 2020, Malaysia needs competent and efficient problem solvers with sound mathematical background.

The importance of mathematics in the current society
Razali and Mohd Yusuf (1993) emphasized the importance of mathematics education which they regarded as a necessary tool to prepare "mathematically literate citizens." Mathematics is the most important tool to encourage the development of civilization in science and technology, socially and economically (Mok, 1993). In a developed nation, those who are equipped with high mathematics competency are able to carry out complex tasks effectively.
and efficiently, especially in management and administration (Mok, 1993). Fong (1993) regarded mathematics as an "indispensable tool," a much needed subject in this age of modern technology.

No major technological nation can afford to let its mathematical base erode away. This is because mathematics underpins all of the sciences and is critical to the development of new areas of technological expertise and their commercial exploitation (Millennium Mathematical Project, 1999). Mathematics is essential in computing, biotechnology, telecommunications, aircraft design, medical imaging, genetic research and many others. The above examples are just a handful of the applications which translate complex mathematical theories into tangible practical benefits (Millennium Mathematical Project, 1999).

In short, to cater for the urgent need of mathematical expertise, students should be prepared to have high mathematical literacy and competency. By having that asset, students who are in the science classes will be more likely to pursue higher education in science courses thus they would pursue wider and more desirable career opportunities. In Malaysia, there have been several efforts carried out to develop mathematics within the nation (Teo, 1997). The seventh Malaysian plan (1996) focused mainly on the development of mathematics. In line with that, the government also intensified its efforts to increase the number of students to opt for Science and Mathematics.

Mathematics anxiety among the students
In spite of the importance of mathematics in this technological age, many intellectually capable students avoid taking mathematics courses in high school and in college and consequently restrict the range of future careers that need mathematics expertise (Betz, 1978). This would form a distinct barrier for them to have desirable career opportunities (Richardson & Woolfolk, 1980).

One concept being used increasingly to explain both mathematics avoidance and poor mathematics performance is that of mathematics anxiety (Stent, 1977; Tobias, 1976). This is supported by Rounds and Hendel (1980) who agreed that mathematics anxiety might contribute to mathematics avoidance and poor mathematics performance. Therefore, to improve on mathematics achievement, mathematics anxiety needs to be alleviated. Otherwise, it will impair students' mathematics performance and achievements.

Most people perceived mathematics as a difficult subject (Bulmahn & Young, 1982; Tobias, 1978). This view was confirmed by Fong (1993) in a Malaysian context. This might explain why students only achieve 72.4% passing percentage in Sijil Pelajaran Malaysia 1997. (Berita Harian, 1998). In Malaysia, mathematics is a compulsory subject throughout eleven years of formal education. Students need to obtain good results in the subject in Penilaian Menengah Rendah (PMR) before they can enroll for science classes in form four. With concrete mathematical backgrounds, the form four science students should fear, dread and feel apprehensive towards the subject. According to Lussier (1996), students with strong mathematical background have less mathematics anxiety.
Problem solving appraisals of the students
Different students manifest different styles when addressing problems of a different nature. Also, different types of problem solving situations require different kinds of levels of knowledge and capability (Wu, Custer & Dyrenfurth, 1996). Three factors that influence people to respond in different ways to their personal problem are logic, feelings and willpower (Barrow, 1982). To be a successful problem solver, these three factors must be fully utilized in working towards the solution.

According to Heppner and Petersen (1981, as cited in Heppner, 1988), the way students appraised their problem solving abilities is related to their general perception of their problem-solving skills. They would perceive themselves as competent problem solvers if they have high problem solving skills. Students would also appraise their problem solving abilities positively if they have confidence and trust in their abilities to solve their problems. Effective problem solvers are more confident in decision making related to their future career (Heppner, 1988). They would also have higher expectation of success in problem solving and would have fewer major stresses throughout their life (Reeder, 1986, as cited in Heppner, 1988).

On the other hand, students who perceived themselves as inefficient problem solvers would be more distressed, depressed, anxious and be more likely to have compulsive behavior (Heppner, 1987, as cited in Heppner, 1988). They are lacking in the confidence necessary to carry out new ideas (Heppner and Krieshook, 1982, as cited in Heppner, 1988). Also, they feel a general sense of helplessness about personal problems (Reeder, 1986, as cited in Heppner, 1988).

Role of problem solving appraisals in moderating anxiety
There was a significant relationship between problem-solving ability and stress level (Fraser and Tucker, 1997). There was also a significant relationship between problem solving ability and mathematics anxiety (Teh, 1996). High problem solving abilities which indicated positive appraisals (Heppner, 1988), were related to low mathematics anxiety. Hence, improving problem solving appraisals might be able to moderate mathematics anxiety levels among the students.

Student should be encouraged to approach mathematical problem solving using exploratory processes to develop concrete levels of understanding (Mc Dougall and Kajander, 1997, as cited in Miller, 1997). In doing so, they need to use critical, logical and analytical thinking and reasoning (Lim, et. al., 1996) while using manipulative and real-life context activities (Miller, 1997). By acquiring all the necessary skills in problem solving, students will develop their problem solving abilities and improve their problem solving efficiency.

Student who perceived their problem solving as positive had higher expectations of success in problem solving (Reeder, 1986, as cited in Heppner, 1988). They would work out the solutions in a systematic way (Heppner, Hibel, Neal, Weinstein & Rabinowitz 1982, as cited in Heppner, 1988). These students would take greater responsibility in their learning and problem solving, hence would dissipate common fears and anxiety about the subject (English, 1997, as cited in Miller, 1997).
Students with positive self-appraisal would also be more persistent in nature (Heppner, et.al., 1982 as cited in Heppner, 1988) and would be most likely to exhibit a sense of perseverance in working on the solution until they were successful. On the contrary, students with negative self-appraisals in their problem solving abilities would believe that things are tougher than they really were, thus narrowing their visions of how best to solve a problem (Pajares, 1996). In addition, students with a positive self appraisal would be most likely to have high problem solving skills that would be able to moderate high levels of anxiety among them (Nezu, 1986).

1.2 Statement of the problem

In an increasingly technological society, knowledge of mathematics is critical to the pursuit of many existing and emerging occupational fields (Carnegie Commission on Higher Education, 1973; Sells, 1973 as cited in Betz, 1978). Science courses with a strong mathematical background would be a platform for the students to further their studies professionally in medical, accounting, engineering and many other fields that are related to science and technology. Students also need to have high mathematics performance and achievement to be knowledge workers. This is because knowledge workers are required in the future workforce that will mainly based on information technology. This situation does not cater to poor mathematics performance, poor mathematics achievement and mathematics avoidance among the students.

Poor mathematics performance and mathematics avoidance are best explained by mathematics anxiety (Betz, 1978). This phenomenon of mathematics anxiety should be relatively low among the science students since they were selected based on the excellent mathematics achievement in Penilaian Menengah Rendah. According to Lussier (1996), students with a strong mathematical background should be less anxious than the ones with a weak mathematical background. Lupkowski and Schumacker (1991) in their study on mathematically talented college students, also agreed that the groups of talented students were less mathematics anxious than most unselected college students. Applying this findings in Malaysian context, the form four science students with strong mathematical background should have better mathematics performance. Hence, it is essential for this study to identify the level of mathematics anxiety among the form four science students to determine whether the findings by Lussier (1996), Lupkowski and Schumacker (1991) will agree with Malaysian students.

The way students appraised their problem solving abilities is related to the perception of their problem-solving skills (Heppner and Petersen, 1981, as cited in Heppner, 1988). Having positive appraisals in their problem solving abilities, students were most likely to have high problem solving skills. However, some students lack the persistence and motivation to achieve the solution because they doubt their capabilities and would tend to give up and weaken their effort (Bandura & Cervone, 1983; Brown & Inouye, 1978; Schunk, 1984; Weinberg, Goald, & Jackson, 1979, as cited in Heppner, 1988). This type of student would be most likely to perceive their problem solving abilities as being negative.

Form four science students were selected students who needed to have excellent overall achievements in Penilaian Menengah Rendah. They could be considered as a group of intelligent students who were regarded as the "cream" among the whole of form four students. Highly intelligent students should have high problem solving abilities as intelligence is a significant factor that determines the problem solving abilities of students.
Based on these findings, another area that needs attention is to identify the way students perceive their problem solving abilities or their problem solving styles.

By having positive appraisals in their problem solving abilities students might consequently be able to moderate their levels of anxiety in general (Nezu, 1986) and mathematics anxiety in particular. This study aims to discover if there exists a relationship between perceptions of problem solving abilities and the level of mathematics anxiety among the form four science students. The existence of such a relationship will enable us to assume that by improving the way students address their personal problems will likely decrease the mathematics anxiety level among them.

1.3 Research questions:
This study examines the following research questions:

i. What are the problem solving styles of form four science students?

ii. What is the mathematics anxiety level of form four science students?

iii. What are the problem solving styles of students with different mathematics anxiety levels?

iv. Is there a significant difference between male and female students in problem solving styles?

v. Is there a significant difference between male and female students in mathematics anxiety?

vi. Is there a significant correlation between problem solving styles, and all three factors, i.e. problem solving confidence, approach/avoidance style and personal control with mathematics anxiety?

1.4 The research hypotheses
The following research hypotheses were formulated from research questions iv, v and vi as presented above:

H₀₁. There is no significant difference in problem solving styles between male and female students.

H₀₂. There is no significant difference in mathematics anxiety level between male and female students.

H₀₃. There is no significant linear correlation between problem solving styles, the three factors (problem solving confidence, approach-avoidance and personal control) and mathematics anxiety.
1.5 Definition of the terms
For the purpose of this study, the terms used in this study are defined as follows:

1.5.1 Personal/General Problems
Personal/general problems refer to the unavoidable situations in everyday life that need a solution but the solution is not known and clear (Krulik & Rudnick, 1980)

1.5.2 Problem solving
Problem solving is an active process where the person accesses stored knowledge and manipulates information in order to achieve a solution. It is a process of accepting a challenge and striving to resolve it. (Polya, 1985)

1.5.3 Problem solving style
Problem solving style refers to student problem solving behaviors and attitudes. It is measured using Problem Solving Inventory (PSI) (Heppner, 1988).

a) Problem Solving Confidence
Problem Solving Confidence refers to the perception of self-assurance the students have while engaging in problem solving activities (Heppner, 1988).

b) Approach-Avoidance Style
Approach-Avoidance Style refers to the perception of general tendency of the students in responding to a problematic situation, i.e. they either approach the problem or avoid it (Heppner, 1988).

c) Personal Control
Personal control refers to students’ perceptions of having personal control over their emotions and behaviors while solving problems (Heppner, 1988).

1.5.4 Anxiety
Anxiety is a phenomenal state and a physiological syndrome that dominates the feeling of fear in human organisms that serves the function of fight or flight from danger (Highland, 1981)

1.5.5 Mathematics anxiety
Mathematics anxiety is 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. It is the feeling of fear and apprehension to specific math-related situations.” (Richardson & Suinn, 1972, Pg. 551).

1.5.6 Form four science students
In this study, form four science students refer to the ones who undertake pure science subjects (biology, chemistry and physics) and additional mathematics. This group of students had sat for the Penilaian Menengah Rendah in the previous year (1998) and obtained good grades in mathematics and science.
1.5.7 Secondary schools
Secondary schools refer to schools that are fully aided and partially aided by the government. They provide five to seven years of formal education with public examinations after three, five and seven years of education.

1.6 Significance of the study
Problem solving has become an important survival skill in our technologically advanced society (Wu, Custer & Dyrenfurth, 1993). The Malaysian curriculum has given a central focus on problem solving, critical thinking and reasoning in mathematics education (Nik Aziz Nik Pa, 1995). However, our present school culture does not permit the full development of critical and creative thinking among the students (Marzano, et. al., 1988, as cited in Nik Aziz Nik Pa, 1995). Students who have high problem solving abilities would indicate positive appraisal and vice versa. The findings from this study might be able to give a clear picture in the way students address their personal problems and how they appraised their problem solving abilities. The findings might also help in determining the percentage of students who have negative problem solving appraisals. Negative appraisals are associated with low confidence in problem solving abilities, tend to avoid problems and low personal control (Heppner, 1988). Appropriate action could be taken in improving the way students address their personal problem solving so that more students would appraise their problem solving abilities positively.

Students with a positive self appraisal of their problem solving abilities would be most likely to have high problem solving skills that might be able to moderate high levels of anxiety among them (Nezu, 1986e). If the findings from this study indicate a relationship between mathematics anxiety level and problem solving styles, improving on problem solving abilities so as to give a more positive appraisal might help in moderating mathematics anxiety.

Moderating mathematics anxiety might improve mathematics performance and achievement. This is essential in preparing the future workforce, who must have high literacy and competency in mathematics. Although it is natural to feel anxious during the mathematical learning process, too much anxiety may be a hindrance in learning as high mathematics anxiety is a very intense and debilitating phenomenon (Sherard, 1981 as cited in Wood, 1988). The findings of the study might be able to determine whether mathematics anxiety is at the level of debilitating the learning process or not. Also, the findings in investigating the mathematics anxiety level among form four science students might help in determining the percentage of students who were highly affected by mathematics anxiety so that appropriate action could be taken to moderate the anxiety level.

To explore the level of mathematics anxiety among students, several related studies have been conducted. Kor (1997) had tried to develop and validate a mathematics anxiety scale for adolescents from form three to form four students. Teo (1997) had investigated the level of mathematics anxiety among preservice mathematics teachers, to find implications for effective counseling. In trying to find the relationship between problem solving and mathematics anxiety, Teh (1996) has found that there is a significant correlation between problem solving skills and mathematics anxiety among form one students in Pahang. However, the investigation had not been carried out to determine whether the way students perceived their problem solving abilities is related to their level of mathematics anxiety. The result of this study will be able to determine if there exists a relationship between
problem solving styles and mathematics anxiety among the form four students and, if so, the strength and the direction of the relationship.

1.7 Limitations of the study
The respondents in this study were form four science students. Considering the fact that these students were chosen from a selected group, the result of the study might not be representative of the entire population of form four students.

Problem Solving Inventory (PSI) is actually measuring problem solving styles based on the students' perceptions of their behaviors and attitudes in addressing hypothetical problem situations. However, it does not measure how the students actually solve problems in real situations. Hence, the data collected in determining problem solving styles were based on the students' perception of their problem solving styles.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction
The purpose of this chapter is to review pertinent literature related to the study. Specifically, it focuses on classifications of problems, problem solving and its styles and the three factors; i.e. problem solving confidence, approach-avoidance style and personal control. In addition, this chapter discusses various definitions and measurements of problem solving styles, individual preferences in approaching problems as well as the implications of problem solving styles on problem solving process. This chapter also considers mathematics anxiety in relation to definitions, measurements, causes, dimensions and its implication on mathematics achievement, performance and avoidance. The relationship between problem solving styles and mathematics anxiety as well as gender issues in both variables are also reviewed. Finally, this chapter attempts to illustrate the framework of the study with a research model.

2.1 Problem Solving
Problems are faced everyday by everyone. It is doubtful that a person can ever spend as long as an hour of his life without solving any problem. So what actually is a problem? According to Lester (as cited in Milton, 1982), problem can be referred to as a situation in which a person could not find a readily available and accessible solution to perform certain tasks. In order to obtain the solution, he has to find and apply a certain method or algorithm that he can think of and sometimes there is no solution at all. Kantowski (1980), also considered a problem as a situation where an individual has no specific algorithm in ensuring a solution to overcome such a situation. Again, he also regarded a task to be a problem if a person could not resolve it by using knowledge immediately available to him (Kantowski, 1977).

2.1.1 Classification of problems
A popular classification of problems is to classify them into well-defined and ill-defined problems. Problems vary in the degree of how well defined they are (Newell 1969; Reitman 1964; Simon 1973, as cited in Lewis & Keith, 1990). In actual fact, there is no precise boundary between well-defined and ill-defined problems rather, it is a continuum of both. To differentiate one from the other, it can be said that a well-defined problem has a clear initial state and goal state. The operators and actions needed to progress from one stage to another are known. A correct answer exists for a well-defined problem. Ill-defined problems, on the other hand, are the ones which a problem solver feels a higher level of uncertainty for with regards to the given information and starting materials. Uncertainty also occurs in choosing the correct operator in order to achieve the final solution. Consequently, choosing the best or most correct solution cannot be carried out with the greatest judgement (Lewis & Keith, 1990).

Virtually all real life or personal problems are actually ill-defined in one way or another (Kendall & Watson, 1992). This seems to be a consequence of the difficulty in defining or representing the real life problem. However, theoretically, there are several ways that one can accomplish this task. In order to do this, problems can be represented in the form of a
mathematical equation or set. They may also be represented in the form of visual image. Nevertheless, representing a problem in the above manner works only occasionally. In actual fact, most everyday problems cannot be represented as conveniently and clearly (Sinnott, 1989, as cited in Kendall & Watson, 1992). For example, we often misunderstand (Green, McCloskey, & Caramazza, 1985, as cited in Kendall & Watson, 1992) or oversimplify (Mayer, 1985, as cited in Kendall & Watson, 1992) information when we attempt to represent it symbolically.

2.1.2 Daily-life problem solving
Problem solving can be regarded as an active process where a person accesses stored knowledge and manipulates information in order to achieve a solution (Jahnke & Nowaczyk, 1998). In other words, to solve a problem, the person's prior experience and relevant knowledge must be retrieved and compiled together to produce the necessary information required. This is supported by Krulik & Rudnick (1993), who regarded problem solving as the process in which an individual uses previously acquired knowledge, skills and understanding to find the solution to a problem. Ideally, students can apply prior knowledge to solve unfamiliar problems (Reed, 1992).

The retrieval of relevant knowledge and past experience into a new situation might speed up the solution of the current problem. However, this tendency of exhibiting the same behavior or approach can sometimes result in rigidity that hinders problem solving success. To be a successful problem solver, an individual needs to create several alternatives, preferably by brainstorming technique, so that he would not be too dependent on the previous experience (Huitt, 1992).

However, when the problem solver has not been successful in creating any possible solution, the person may temporarily withdraw from the problem and engage in other activities. This rest period is known as an incubation stage in which problem solving activity continues, but without conscious attention to the problem (Ellis & Hunt, 1993). Incubation appears to be sufficiently useful and it is recommended when the effort to solve problems has been unsuccessful. Wickelgren (1974), however, noted that there is very little evidence to consistently support this concept of incubation as "the pause that refreshes."

Newell and Simon (1972), the two famous problem solving theorists, described problems in terms of their problem space, initial state, current state, goal state, and operators. Problem space represents the way the solver views and perceives the task's environment. The initial state and the current state represent the beginning situation and the current situation, respectively. The goal state is considered to be the final state of the situation and representing the solution of the problem. Operators are means to get to the solution of the problem. When the difference between the initial state and the goal state has been removed by making use of certain operators it means that the solution is obtained.

In general, problem solving can be divided into five interacting components (D'Zurilla, 1986a; D'Zurilla & Goldfried, 1971; D'Zurilla and Nezu, 1982; Nezu, 1987; Nezu, Nezu and Perri, 1989, as cited in Kendall and Watson, 1992).
i. Problem orientation:
The problem orientation is a motivational process that includes the expectations of a person regarding his life's problems and his appraisal of his general problem solving ability.

ii. Problem definition and formulation:
The problem definition and formulation involves the identification, clarification and understanding of the specific nature of the problem.

iii. Generation of alternatives:
The generation of alternatives will generate as many available solutions as possible in order to maximize the likelihood that the "best" (most preferred) solution will be found.

iv. Decision making:
The purpose of decision making is to evaluate the available solution alternatives that have been generated and select the best one(s) for the implementation in the actual problematic situation.

v. Solution implementation and verification:
The solution implementation and verification will monitor the solution outcome and evaluate the "effectiveness" of the solution in managing and solving the problematic situation.

All problems have negative and positive elements (Brehm, 1997). Focusing on negative, threatening elements, the emotional state will tend to be negative. However, in focusing on potential benefits of the solution, the emotional state will tend to be positive and this will decrease distress and anxiety (Brehm, 1997). With that, the problem solving ability will be enhanced.

2.1.3 Types of Individual Preferences in Approaching Daily-Life Problem Solving
Daily-life problem solving can also be regarded as a process in which we perceive and resolve a gap between a present situation and a desired goal, with the path to the goal blocked by known or unknown obstacles (Huitt, 1992). The relationship between the way students approach problem solving and their individual preferences has been investigated (e.g., Lawrence, 1982, 1984; McCaulley, 1987; Myers & McCaulley, 1985 as cited in Huitt, 1992). In relation to that, three types of individual preferences in approaching problem solving had been identified (Huitt, 1992):

a) Introversion versus Extraversion
In introversion, individuals prefer to take time to think and clarify their ideas before they begin talking. They will more likely to be concerned with their own understanding of important concepts and ideas. On the hand, those who prefer extraversion will want to talk through their ideas in order to clarify them. They will continually seek feedback from the environment about the viability of their ideas (Huitt, 1992).

b) Factual versus Intuition
Those who prefer factual will be more likely to pay attention to facts, details, and reality. They will also tend to select standard solutions that have worked in the past. Individual with
intuition preferences will more likely attend to the meaningfulness of the facts, the relationships among the facts, and the possibilities of future events that can be imagined from these facts. In contrast to those with factual preferences, those with intuition preferences will exhibit a tendency to develop new, original solutions rather than to use what has worked previously (Huit, 1992).

c) Thinking versus Feeling
Individuals with a thinking preference will tend to use logic and analysis during problem solving. They are also likely to value objectivity and to be impersonal in drawing conclusions. They will want solutions to make sense in terms of the facts, models, and/or principles under consideration. By contrast, individuals with a feeling preference are more likely to consider values and feelings in the problem solving process. They will tend to be subjective in their decision making and to consider how their decisions could affect other people (Huit, 1992).

The minimal three elements required for problem solving and decision making are a knowledge base, an adequate level of thinking and communication skills, and an organized approach or strategy to solve problems (Woods, 1987). The way individuals address their personal problem solving are influenced by three factors: feelings, logic and willpower and these three factors must be fully utilized to give the required solution (Barrow, 1982).

2.1.4 Problem Solving Styles
In the daily life of students, they will encounter many new and complex problems that need to be solved. There are a lot of individuals who face problems that could not be resolved by themselves (Fretz, 1982; Krumboltz, 1965; Mahoney, 1974, as cited in Heppner, 1988). Researchers have not yet developed a technology that can assist in problem solving and decision making (Horan, 1979, as cited in Wu, Custer & Dyrenfurth, 1996). Currently, a computer-based system known as Decision Support System has been developed to support decision-makers and problem solvers (Turban & Aronson, 1998). However, it is only applicable in managerial systems and does not function to support personal problem solving processes and decision making.

How does a student respond to and deal with a problem? Some of them might be brave and confident enough to face the problems and trying to tackle it to their best of well being. But others might try to run away from the problem wishing that it would disappear on its own or pretend that no problem exists. Some students might take the responsibility to deal with the problem but some try to blame themselves for the existence of the problem (Brehm, 1997). Blaming oneself for certain problems leads to low self-esteem and doubts about one's ability to solve it (Brehm, 1997). This creates stress and anxiety which in turn, makes it difficult to address problems effectively.

2.1.5 Defining problem solving styles
Problem solving style is defined as a tendency to respond in a certain way while addressing problems but does not explain the actual steps employed (Heppner, 1988). It only assesses one's perception of problem solving capabilities but does not actually assess actual problem solving skills (Heppner, 1988). In addition, problem solving styles assess an individual's perception of his own problem solving behaviors and attitudes (Wu, Custer & Dyrenfurth,
1996). It describes how an individual behaves and reacts when he or she faces a personal problem. Problem solving style also reflects on how the individual evaluates his or her problem solving abilities or style. It provides a global appraisal of that individual as a problem solver (Wu, Custer & Dyrenfurth, 1996). Individuals could either perceive themselves of having positive, negative or combination of both positive and negative appraisals.

According to Heppner et. al (1981), problem solving styles describe how people solve real-life personal problems. The personal problem solving approach is a complex chain of events that consists of innumerable cues, behaviors, critical choice points, and consequences (Heppner, et. al, 1981). It is a goal-directed sequence of cognitive operations (Anderson, 1980, as cited in Heppner, 1988) employed for the purpose of adapting to external or internal demands or challenges (Sternberg & Salter, 1984 as cited in Heppner, 1988). It has been operationally defined by in terms of three distinct dimensions, which can be measured by the Problem Solving Inventory (PSI). Collectively, these dimensions (problem-solving confidence, approach/avoidance, and personal control) comprise problem solving style.

2.1.6 Measuring problem solving styles

Personal Problem Solving Inventory (PSI) was designed by Heppner in 1988. This inventory is a standardized self-reporting measure designed to assess perceptions of personal coping problem solving styles and abilities. Factor analysis revealed three factors: (a) problem solving confidence, (b) approach/avoidance, and (c) personal control. In essence, people who perceive themselves as effective problem solvers (having high confidence, high personal control, and a positive attitude on approaching problems) differ significantly from those who perceive themselves as ineffective (lacking in confidence and personal control, and avoiding problems). In addition, the PSI has been found to be significantly correlated with behavioral observations of actual problem solving competence (cited in Heppner, 1988). After retest, reliability estimates revealed that the three factors were internally consistent (coefficient alpha a = 0.72 to 0.90) and stable over a two week period (0.83 to 0.89).

Another instrument, Personal Problems Inventory, was designed by Johnson and Holland (1986) to assess client's expectations of their ability to solve personal problems. After being analyzed, four factors emerged, each representing a separate domain of personal problems: Performance Anxiety Problems, Interpersonal Problems, Intrapersonal Problems, and Substance Abuse Problems. This instrument was used to measure the students abilities to solve personal problems, their attitudes, and coping with their personal problems.

2.1.7 Three Factors in Problem Solving Styles: Problem Solving Confidence, Approach/Avoidance Style, and Personal Control

Heppner (1988) has defined three distinct factors in problem solving styles, i.e. Problem Solving Confidence, Approach/Avoidance Style, and Personal Control. Students who perceived that they have positive appraisals in their problem solving abilities would have high problem solving confidence, adopt the approach style and have high personal control in problem solving activities.