AN ABSTRACT OF THE THESIS OF

SULAIMAN BIN YAMIN for the degree of Doctor of Philosophy in Science Education presented on August 2, 1988.

Title: Frequency of Testings and its Effects on Achievement in Chemistry, Test Anxiety and Attitudes Toward Science at University Technology of Malaysia.

Abstract approved: Redacted for Privacy

The purpose of this study was to determine the effects of frequent versus conventional testing on Chemistry achievement,test anxiety, and attitudes toward science of students enrolled in general chemistry classes at the University Technology of Malaysia. The subjects consisted of 278 students taking first year Chemistry at the University Technology of Malaysia. The students were given a pretest and posttest in achievement, test anxiety, and attitudes toward science. The instruments included an achievement test in chemistry made up of selected items from previous American Chemical Society Cooperative Examinations and translated versions of the State Trait Anxiety Inventory and Science Attitude Questionnaire. Pretest scores were used to assign students randomly into

experimental and control groups. The experimental group was subjected to frequent testing, while the control group was subjected to conventional testing. The data were analyzed using one-way and three-way analysis of covariance. The analysis revealed significant differences between the experimental and control groups in student (a) achievement in chemistry with the experimental group achieving at higher levels and (b) test anxiety with the experimental group having lower test anxiety than the control group. No significant difference was found in students attitudes toward science between the experimental and control groups.

It was concluded that first year Chemistry students at the University Technology of Malaysia achieve significantly higher in chemistry when they are subjected to frequent rather than conventional testing. It was further concluded that frequent testing was significantly more effective than conventional testing in lowering student test anxiety.

FREQUENCY OF TESTING AND ITS EFFECTS ON ACHIEVEMENT, TEST ANXIETY AND ATTITUDES TOWARD SCIENCE OF STUDENTS AT UNIVERSITY TECHNOLOGY OF MALAYSIA

by

Sulaiman Bin Yamin

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Completed August 2, 1988

Commencement June 1989

APPROVED:

Redacted for Privacy

Professor of Science, Mathematics, and Computer Science Education in charge of major

Redacted for Privacy

Chairman of Science, Mathematics, and Computer Science Education

Redacted for Privacy

Dean of Graduate School

Date thesis is presented August 2, 1988

Typed by Rimah Che Latif for Sulaiman Bin Yamin

ACKNOWLEDGEMENT

I am deeply grateful to my advisor, Dr. Thomas P. Evans, for his patience, advice, support and encouragement throughout my study at Oregon State University.

Sincere appreciation is extended to the members of my doctoral committee: Dr. Margaret Niess, Dr. E. Wayne Courtney, Dr. K. Jake Nice, Dr. A. Wallace and Dr. Huang Lau. Special thanks go to Dr. E. Wayne Courtney for his help and suggestions.

The help and support from Dr. Helen Berg, the director of Survey Research Center and Suzi Maresh are acknowledge with gratitude.

This study would not have been possible without the willing cooperation and professional assistance of the following University Technology Malaysia Instructors: Associate Professor Dr. Yusof Bakar, Dr. Ramli Hitam, Dr. Mustapha Nawawi, Dr. Rusmidah Ali, Dr. Noreini Idris, En. Nasir Katun, Puan Faridah, En Husni Mohd., En. Zain Shariff, Puan Norfadillah Hitam, En. Yusof Arsad, Dr. Satapah Ahmad and Dr. Zakaria Bhari.

This dissertation could not have been completed without the love, patient understanding, and help of my wife and children.

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CHAPTER I

INTRODUCTION

Measures of amount learned (i.e.achievement) are often used in educational research, and achievement is one of the major goals of education (Borg, 1983). During instruction, testing and evaluation provide a means of (a) diagnosing learning progress and (b)diagnosing learning difficulties. Thus periodic evaluation during instruction provides a type of feedback or corrective procedure so that instruction is continuously adapted to group and individual needs (Grondlund, 1985).

Evidence indicates that educators increasingly view testing as a means of improving student achievement (Bloom, 1971). Evidence also indicates an increasing tendency for educators to view classroom testing as an integral part of the teaching-learning process (Grondlund, 1985). The fact that tests influence learning seems particularly true of the frequently administered teacher-devised tests that are closely involved with day-to-day teaching-learning activities in the classroom. Thorndike and Hagen (1977) stated, "Testing procedures control the

learning process to a greater degree, perhaps, than any other teaching device" (p. 28). The teacher-devised examinations can be used not only to evaluate student progress but also to facilitate student learning; however, few teachers take full advantage of tests as a teaching aid. Koester (1957) stated, " Unfortunately tests are too frequently used only to evaluate the scholastic progress of students and consequently the instructional possibilities are minimized" (p. 208).

If one assumes that tests facilitate learning, then the question arises as to what causes this facilitating effect. Many explanations have been advanced, such as knowledge of progress, reducing of anxiety, extrinsic motivation, reinforcement, structuring of the course, guiding student study, and forced practice with the material. Few of these explanations however, are well supported by research evidence (Marso, 1970). lt has been shown by research evidence that test anxiety inhibits student performance and changing the testing procedure could reduce the inhibiting effects (Wine, 1971).

Research studies on the relationship of student's attitudes to teacher and classroom characteristics seem to indicate that a student's attitude may be associated with some classroom learning and instructional and teacher variables. Students' perceptions of some aspects of the classroom learning environment were found to be sig-

nificantly related to their attitudes toward science (Frasher, 1978; Gardner, 1976; Lawranz, 1975). Also, students' attitudes toward science seem to be influenced significantly by their achievement in science and their self-concepts (Campbell & Marting-Prez, 1977;Simpson & Wasik, 1978).

Rationale and Theoretical Framework of the Study

The rationale or theoretical framework of the study is drawn from six areas. These six areas are as follows:

1. Test anxiety and achievement.
2. Frequent Testing and Achievement.
3. Frequent Testing and Test Anxiety.
4. Frequent Testing and Attitude Toward Science.
5. The effect of frequent testing on achievement, test anxiety and attitudes toward science.
6. Background of the problem.

Each of these areas is discussed in the following paragraphs.

Test Anxiety and Achievement

According to the state-trait model of test anxiety

(Spielberger, 1966), the components of test anxiety may be diagrammed as shown in Figure 1.

Figure 1

The State-Trait model of test anxiety

(Test Stimuli)⟶(Interpretation of test stimuli) ⟶(A-State Reaction)
↓
(Coping, Avoidance, Defensiveness)←(Cognitive Reappraisal)

Test Stimuli are those stimuli which the individual associates with evaluation. These may be immediate events, such as a teacher's remark, "we will have a quiz today," or "John, how would you answer that?" Or, they may be related to the future, such as the decision to major in a premedical program with the knowledge that four years later one will be faced with MCAT exams and with personal interviews at the medical schools. Test stimuli are conditioned stimuli. Their meaning to the individual depends on prior experience. Thus, what is a stimulus of test anxiety for one may be a neutral event for another.

Interpretation of Test Stimuli depends on the nature of one's prior experience with these stimuli. They may be perceived as having interesting or positive meaning, as threatening, or as neutral. Some individuals can approach an evaluation as a positive event. For example, one may approach a test with the mature view that

he or she will either succeed or not in meeting his or her expectation in this instance, and he or she will learn and grow from whatever happens. This is in marked contrast to those whose fear of failure causes them never to set out to achieve, to focus narrowly and intently on one area of achievement at the expense of failing to develop in other areas, or to bungle through a challenging task. It is important to remember that the interpretation of test stimuli is, by definition, an interpretation based on one's own past history. Thus, fear of failure and other negative interpretations of test stimuli are not fear of failing to carry out the operations required at the time. Rather, these negative interpretations involve plugging in to old ideas, such as "If I fail at this, my life will be less worthwhile," or "I will have fulfilled my father's views that I am not worth anything," or "No one will respect me."

A-State Reactions vary depending on interpretations of prior experience and on the nature of the test stimulus. The A-state reaction may consist of heightened arousal, vigilance and a sense of enthusiasm, or it may include fear and worry, confusion, illness, anger, lowering of self-esteem and other negative events.

Cognitive Reappraisal refers to the way in which an individual responds to his or her A-state. These responses may be constructive, defensive, avoidant, or a combination

of these kinds of responses.

<u>Coping, Avoidance, and Defensiveness</u> refer to the nature of the feelings, approaches, and actions in which one engages. A wide range of approaches and outcomes may occur; for example, the task may be successfully or unsuccessfully completed. It may be consciously and confidently addressed, fearfully approached, avoided, or blundered through. The nature of one's performance may be fully acknowledged, denied, or blamed on someone else. The individual may feel good, bad, unaware, or indifferent about the task and the performance.

As this general model suggests, there are adaptive test anxiety processes that healthy people experience everyday, and there are maladaptive processes to which we refer when we speak of high anxiety. People who experience high anxiety in test situations are very sensitive to cues that suggest the imminence of testing and interpret testing situations as a serious threat to their well-being. The resulting A-state response is a powerful, unpleasant, and disruptive emotional reaction. The cognitive reappraisal typically involves considering a number of unconstructive ways to deal with the test and with the anxiety. The coping behaviors that follow are less constructive and effective than is desirable and may be accomplished by defensive and avoidant behavior.

Thus, we must distinguish between two meanings of

the term, test anxiety-- anxiety as a state and anxiety as a trait (Spielberger, 1966). State anxiety is a transitory state that occurs when the individual perceives stimuli of a (real or imagined) test and responds with certain emotions and behavior. Trait anxiety refers to a relatively stable personality characteristic.

Evaluation situations that threaten self-esteem evoke high levels of A-State response in high A-Trait individuals than in persons low in A-Trait. Differential level of A-State reaction is related to level of performance in intellectual tasks (Hodges, 1968). In contrast, physical danger does not evoke such differential A-State responses; rather, it evokes a similar increase in A-State for high and low A-trait persons (Lamb, 1969).

Sarason and Mandler (1952) who are famous investigators of anxiety and learning, believe that testing situations evoke both learned task drives and learned anxiety drives. Some of the anxiety drives are task relevant while others are task irrelevant. The learned task drives and the task-relevant anxiety drives facilitate test performance while the task-irrelevant anxiety drives decrease test performance. A debilitating anxiety is suffered by the high test-anxious person during examination, resulting in a lowered performance.

Two response components of test anxiety are (a) autonomic reaction and (b) cognitive reaction. Autonomic

reactions include sweating and accelerated heart rate. An example of cognitive reaction is saying to oneself while taking a test, "I am stupid," or "Maybe I won't pass. Saying such things to oneself interferes considerably with attention to the task at hand, whether or not it is one that requires learning or figuring out the answers to certain questions. Worry is unmistakenly an attention demanding and emotionally arousing cognitive activity (Sarason, 1975).

The self-preoccupying thoughts of a highly anxious individual may interfere with adaption at several points in the course of information processing. They may narrow or otherwise influence the attention given to environmental cues; distort encoding, transformation and planning strategies; and influence responses that are selected to cope with the situation (Sarason, 1975). Highly anxious persons under stress experience cognitive interference and preoccupation that make time pass slowly and result in poor performance (Stoops, 1978).

Self-oriented, interfering worry responses are but one component of test anxiety--the cognitive component. There is also a physiological, affective component of test anxiety--the emotional component. Worry has been found to be significantly, negatively related to both performance expectancy (Liebert & Morris, 1967; Spiegler, Morris & Liebert, 1968) and examination performance (Deffenbacher,

1977; Doctor & Altman, 1969; Morris & Liebert, 1969, 1970). Emotionality seems to be unrelated to examination performance with participants reporting a lessening of emotionality during the course of and following an examination (Smith & Morris, 1976).

Most of the above studies were conducted in psychology or liberal arts. The scale or instrument used in the earlier studies has been critised for being easily falsified (Allen, 1970). This reveals that there is a need to do research on test anxiety and achievement in science areas using better scales that will lead to more valid and reliable findings.

Frequent Testing and Achievement

More frequent testing and timely feedback can provide a closed-loop-feedback evaluation which can be beneficial to student and instructor. With a closed-loop-feedback evaluation system, the student has the opportunity to profit from his or her mistakes and then demonstrate improvement. The instructor is able to continually analyze, restructure when necessary, and improve his or her teaching methods within a given unit of study (Stokes, 1973). Frequent testing can also help the student indirectly see the structure of the course (Standlee, 1960).

Conventional testing may not provide such advantages, because of time constraints. Conventional testing also may not provide in-depth study of the course materials as much larger amounts of materials have to be covered for the testing (Stokes, 1973).

Research on the effects of frequent testing on achievement was started in the early thirties. Studies by researchers (Fitch, 1951; Kulp, 1934; Marso, 1970; pikumas, 1965; Sumprer, 1982) showed that the group under frequent testing achieved higher than the group under less frequent testing. In contrast, however, studies by researchers (Monk, 1971; Noll, 1939; Selakovich, 1962; Stokes, 1973) showed that the group under frequent testing did not achieve any better than the group under less frequent testing.

A review of the studies suggests that many of the earlier studies were poorly designed. As a result, some findings are doubtful. There is a need to conduct more research in this area to confirm the effect of frequent testing on achievement.

Frequent Testing and Test Anxiety

According to attentional theory of test anxiety, it should be possible to negate the deleterious effects of test anxiety by helping the child focus attention more

directly on the task (Dusek, Kermis, & Mergler, 1975; Dusek, Mergler & Kermis, 1976; Wine, 1971). Later research also indicates that providing task-relevant strategies helps anxious children better attend to evaluative tasks and increases their performance. Other research (Sarason, 1972) indicates that providing task-oriented instructions, cues about expected performance, task-effective models and memory supports facilitate all the performance of anxious persons in testing situations. lt is also assumed by Sarason that frequent testing helps in one way or another to lessen the negative effects of test anxiety. According to Sarason, frequent testing helps to divide the course or task at hand, thus lessening the problem of study and stress. Therefore, frequent testing helps to reduce test anxiety.

The literature on the effect of frequent testing on test anxiety reveals a scarcity of studies. The available studies showed that the less anxious students scored higher in achievement than the more anxious student (Fulkerson, 1981; Stokes, 1973; Sumprer, 1982). However, these studies were not directed toward finding the effect of frequent testing on test anxiety. The studies of Fulkerson (1981) and Sumprer (1982) with the exception of Stokes (1973) were in liberal arts or psychology.

The above information demonstrates a need to conduct studies especially in chemistry to shed light in

the above-mentioned area and confirm the results of the findings.

Frequent Testing and Attitudes Toward Science

Science educators and teachers of science unanimously agree on the development of attitudes as a goal for science teaching. The development of attitudes includes both the development of scientific attitudes and the development of attitudes toward science. Attitudes toward science include the feelings, opinions, beliefs in and about, and appreciation which individuals have formed as a result of interacting directly or indirectly with various aspects of the scientific enterprise, and which exert a direct influence on their behavior in science endeavors(Allport, 1967). Scientific attitudes are characterized as objectivity, open-mindedness, skepticisms and a willingness to suspend judgment (Gauld, 1982; Burnett, 1944; Noll, 1933).

The development of favorable attitudes toward science and scientists is considered important for two main reasons. First, attitudes influence to a considerable degree an individual's learning of science and use of the scientific information (NASTA, 1968; Wood, Pella & O'Hearn, 1968). Second, the possession of favorable attitudes toward science is an important characteristic of

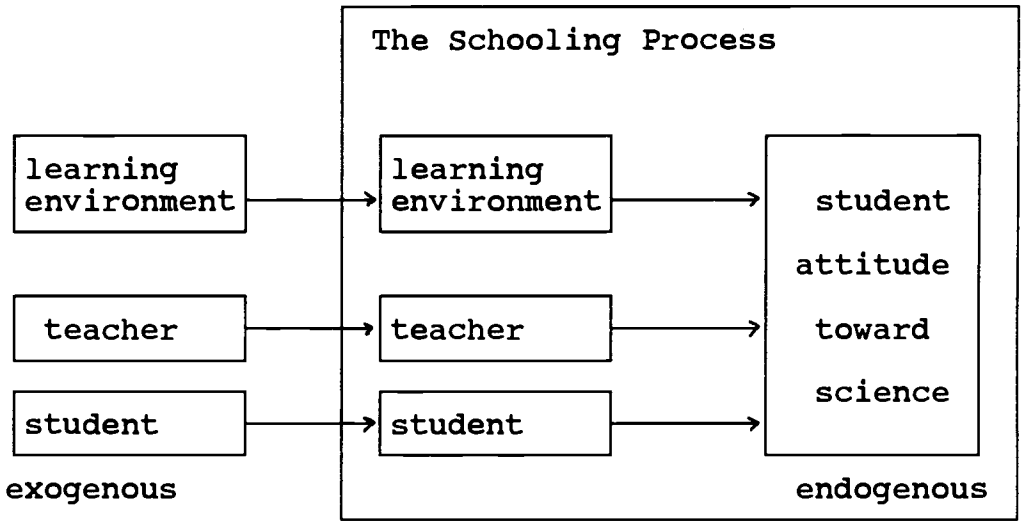
a scientifically literate person (NASTA, 1968; Wood, Pella & O'Hearn, 1968). Science teaching, as Hurd (1968) asserts, must result in scientifically literate citizens if it is to meet the challenging demands of change.

From the theoretical model of Haladyna, Olsen and Shanghnessy (1982), student attitudes toward science are influenced by three factors: (a)the learning environment, (b) the teacher, and (c) the student.

Figure 2 shows the model of attitudes toward science.

Figure 2

The attitudes toward science model



Exogenous variables are "givens" in the schooling process and cannot be manipulated (i.e., teacher's age, gender of student, physical condition of the school building, and social-economic status of the neighborhood where the class members reside). Endogenous variables can

be manipulated and may produce changes in attitudes. These variables reside within the schooling process, often under the direct control of the teacher and include class environment, formality and teacher praise and reinforcement of students. Although student attitude may result from the long-term effects of schooling, a combination of the teacher, learning environment and other factors in a science classroom may have much to do with modifying attitudes at the classroom level. If this is true, then classroom intervention programs may be developed that could affect the attitudes of a great numbers of students (Haladyna, 1982).

It has been emphasized throughout the literature that various science teaching strategies may increase or decrease students' science achievement and attitudes toward science (Bates, 1978; Case,1980; Mayfield, 1976; Tamir, 1976). Few investigators have dealt with the relationship between frequency of testing and attitudes toward science (Haladya, 1982). Students' attitudes toward science are influenced significantly by their achievement in science and self-concept (Simon & Wasik, 1978). Also, since frequent testing facilitates learning and achievement (Marso, 1970), there is a direct possibility that attitudes toward science could also be influenced by frequent testing.

The Effect of Frequent Testing on Achievement, Test Anxiety and Attitudes Toward Science

No single study was found that combined the effects of frequent testing on achievement, test anxiety and attitudes toward science. There were studies on the effect of frequent testing on achievement and also studies on the effect of frequent testing on achievement and test anxiety but not the three together. This reveals a need for such research.

Background to the Problem

In Malaysia, when students enter colleges and universities, they do so with various backgrounds and experiences, attitudes and wide ranges in abilities and aptitudes. It is important that these students be placed in the school or college curriculum in which they can perform effectively. As most of the students are receiving funds or loans from the government, their failure in college means a loss of human resources and taxpayer money. Therefore, in the interest of both the students and society, research should be aimed at identifying curriculum and teaching methods that increase the probability of their success or achievement.

Malaysia has developed a centralized educational system to monitor education in the country. In this

centralized system of education, students are exposed or subjected frequently to nationwide evaluations. In elementary school, there are two nationwide evaluations, and in secondary school, there are also two nationwide evaluations. Each of these evaluations may prevent students from continuing their educations. All these evaluations are formal and place the students in a state of high stress and anxiety because their future highly depends upon their scores. Parents and society have high expectations in this instance. Science courses are considered to be more demanding and difficult compared to liberal arts courses and, as a result, some of the students have to be forced to take science after their junior high school years. Consequently students are placed in a situation conducive to high test anxiety.

Malaysia, being a fast-developing country, tends to grasp all the available methods of teaching from abroad and incorporate them into its educational system. After following the British system for many years, Malaysia now favors the American system of education. Four out of seven universities are following the semester system; however none of these four has conducted research or properly investigated the system they are adopting. At the same time, evaluation continues to be formal and public and, as a result, anxiety among the students is high. Since most of the students come from a varied background and ex-

periences, their attitudes toward science are assumed to be varied as well. As many studies show, there is a strong relationship between achievement and attitudes. Once again, we see a need to conduct research in this area.

Summary of the Theoretical Framework

The major items forming the theoretical framework of this study are summarized in the following sections: 1. Test anxiety and achievement, 2. Frequent testing and achievement, 3. Frequent testing and test anxiety, 4. Frequent testing and attitudes toward science, 5. The effect of frequent testing on achievement, test anxiety, and attitudes toward science, and 6. Background of the problem.

Test Anxiety and Achievement

Studies of test anxiety and achievement, suggest that test anxiety is related to achievement. That is, students with low test anxiety usually performed higher on achievement tests than students with high test anxiety. Most of these studies were in liberal arts and none in science. It has also been a criticizm that most of the studies were poor and the instruments used were easily falsified; raising doubts as to the validity of the

findings. In spite of the criticisms, so many studies have shown the same results that such a relationship is likely to exist. It is also known that,in general, anxiety in science is high (Mallow, 1983), and this high anxiety in science is especially true among the Malaysian students. Since anxiety in science is reflected strongly in test anxiety (Mallow, 1986), this study will focus on the problem of test anxiety in science areas.

Frequent Testing and Achievement

Many of the reviewed studies have been criticized for having poor design and have caused doubt as to the validity of the findings. Most of studies were in the liberal arts. Therefore it is important to further investigate the relationship between frequent testing and achievement, especially in sciences.

Frequent Testing and Test Anxiety

The literature on the effect of frequent testing on test anxiety reveals a scarcity of studies. Most of the available studies were in liberal arts or psychology. Therefore, there is a need to conduct study in this area especially in sciences or chemistry to confirm the findings.

Frequent Testing and Attitudes Toward Science

There is no study that questions the effect of frequent testing on attitudes toward science. This is an area in need of investigation.

The Effect of Frequent Testing on Achievement, Test Anxiety, and Attitudes Toward Science

No single study was found that combined the effect of frequent testing on achievement, test anxiety and attitudes toward science. This reveals a need for research in this area.

Background of the Problem

Malaysia, being a fast developing country tends to grasp all the available methods of teaching from abroad to be adopted into its educational system. Four out of seven universities are following closely the semester system. None of these four universities has conducted research or properly investigated the system they are adopting. At the same time, evaluation is considered formal and public and, as a result, anxiety among the students is high. As most of the students come from varied background and experiences, their attitudes toward science are assumed to be

varied as well. Consequently, there is a need to conduct research in this area.

Statement of the Problem

This study investigates relationships among student testing, anxiety, attitude, and achievement in chemistry courses at college level. It considers the effect of conventional testing and frequent testing on student achievement in chemistry. Also it attempts to determine if frequent testing results in lower test anxiety. It further attempts to determine if frequent testing results in improving student attitudes toward science.

The purpose of the study is to investigate the following:

1. Which of the two approaches (i.e., frequent vs. conventional) to testing in a general chemistry for college students at University Technology of Malaysia would result in greater achievement in chemistry?

2. The effect of these approaches of testing on students test anxiety.

3. The effect of these approaches of testing on students attitude toward science.

The Research Hypotheses

The objectives of the study were to obtain data that could be used to test the following null hypotheses:

1. There is no significant difference in achievement in general chemistry between the control and experimental groups.

2. There is no significant difference in achievement in general chemistry between students with high test anxiety in the control and experimental groups.

3. There is no significant difference in achievement in general chemistry between students with low test anxiety in the control and experimental groups.

4. There is no significant difference in achievement in general chemistry between students with positive attitudes toward science in the control and experimental groups.

5. There is no significant difference in achievement in gneral chemistry between students with negative attitudes toward science in the control and experimental groups.

6. There is no significant difference in achievement between students with high and low test anxiety irrespective of the control and experimental groups.

7. There is no significant difference in achievement between students with positive and negative attitudes

toward science irrespective of the control and experimental groups.

8. There is no significant difference in mean test anxiety scores between the control and experimental groups.

9. There is no significant difference in mean attitude toward science scores between the control and experimental groups.

A 0.05 level of significance was used as a basis for rejecting the hypotheses.

Assumptions

1. It is assumed that the American Chemical Society Cooperative Examination is a valid and reliable instrument for measuring chemistry performance of the University Technology of Malaysia students in General Chemistry.

2. It is assumed that the State-Trait Anxiety Inventory is a valid and reliable instrument for measuring test anxiety of the University Technology of Malaysia students in General Chemistry.

Limitations

1. The study is limited to the students at the University Technology of Malaysia who enrolled as first-

year students in General Chemistry.

2. The study is limited to the extent that students respond honestly to questions on test anxiety and attitudes toward science.

Delimitations

1. No attempt is made to evaluate the effectiveness of chemistry instruction.

Definitions of the Terms

Achievement - Refers to the raw score values of the American Chemical Society Cooperative Examination in General Chemistry.

Attitudes Toward Science - The feeling, opinions, beliefs in and about, and appreciations which individuals have formed as a result of interacting directly or indirectly with various aspects of the scientific enterprise and which exert a directive influence on their behaviors toward science (Allport, 1967). It is measured by the Science Attitude Questionnaires (Sumner, 1971).

Control Group - Refers to students who are randomly assigned to the conventional testing.

Conventional Testing - Refers to multiple choice tests given at equidistant intervals during the semester, as is

the usual practice in the Chemistry Department at the University Technology of Malaysia. The instructional units in the course are divided into the number of examinations in sequential order.

Experimental Group - Refers to students who are randomly assigned to the frequent testing.

Frequent Testing - Refers to a multiple choice test, given every two weeks during the semester. This resulted in a total of six tests in a semester. The instructional units of the course are examined in sequential order.

Subgroup - Composed of students who are assigned according to pretest scores on State Trait Anxiety Inventory and attitude-towards-science scale and chemistry pretest.

Test Anxiety - An unpleasant feeling or emotional state that has physiological and behavioral concomitant, that is experienced in formal testing or other evaluative situations (Sarason, 1975, 1978). It is measured on State Trait Anxiety Inventory.

Methodology

The population of the study was composed of 278 males and females taking first-year chemistry. The students were given pretests at the beginning and post-tests at the end of the semester in chemistry, in test anxiety, and in attitudes toward science. Scores from the

pretests were used to divide the students randomly into experimental and control groups. The experimental group received frequent testing and the control group received conventional testing.

The statistical methods used to analyze the data consisted of two techniques. A three-way analysis of covariance was used to analyze the differences in chemistry achievement, while one-way analysis of covariance was used to analyze data on differences in test anxiety and attitudes toward science.

Outline of the Remainder of the Thesis

Chapter II presents the background for the study and related literature. It is divided into five sections. (a) Malaysia and the Development of its Educational System,
(b) University Technology of Malaysia, (c) Test Anxiety and Examination Performance, (d) Frequent Testing and Achievement, and (e) Frequent Testing and Attitudes Toward Science.
Chapter III presents the methodology of the study. The analysis and interpretation of the findings are reported in Chapter IV. Summary, conclusions and recommendations are presented in Chapter V.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter is organized into four sections. Section one describes the country where the research was conducted. Section two covers the development of education in Malaysia. Section three is devoted to discussing frequent testing, achievement, and test anxiety. Section four examines frequent testing and attitudes toward science.

Background and Setting

Malaysia is made up of the Peninsular Malaysia and the states of Sabah and Sarawak of the island of Borneo. Originally, Peninsular Malaysia was known as Malaya. The total area is about 128,000 square miles. Its population in 1980 was about 14 million (Kurian, 1980). About 85 percent of the population is found in the peninsula. Peninsular Malaysia consists of 12 states, namely, Perlis, Kedah, Penang, Perak, Selangor, Kuala Lumpur, Negeri Sembilan, Malacca, Johor, Pahang, Terengganu and Kelantan. Penang, Perak, Selangor, Negeri Sembilan, Malacca and Johor are the most developed states of the peninsula. The other areas constitute the east coast states of Pahang,

Terengganu and Kelantan and the northern state of Kedah and Perlis. The last two areas are the least developed of all (Third Malaysian Plan, 1976-1980).

Education is the responsibility of the Federal government, but the policy and system of administration of education in Sarawak and Sabah are more or less independent. There is, however, a provision made that Sabah and Sarawak would remain under the control of these states until they decide otherwise (Wong and Ee, 1971). To date, the two states have agreed to follow the educational pattern developed by the central government in Peninsular Malaysia.

The economy of the country operates on a free-enterprise basis. The currency of Malaysia is relatively stable (Currently an American dollar is equal to 2.49 Malaysian Ringgit). Per capita income was about $1778.00 Malaysian Ringgit (about 714 dollars in the United States) in 1975. This income is regarded as one of the highest in Asia, coming next to Japan and Singapore.

Every state is headed by a Ruler. The states of Sabah and Sarawak, Penang, and Malacca, however, are headed by a Governor. The latter were the former states known as the British Protectorates. The head of the Federation of Malaysia is the King elected by the respective heads of state for a five-year term. The Malaysian parliament is comprised of two houses, the Senate and the

House of Representatives. The former has 58 members while the latter has 144 members, 104 for Peninsular Malaysia, 24 for Sarawak, and 16 for Sabah, all serving a five-year term.

The government is run by a cabinet of Ministers headed by a Prime Minister. Ministers must be members of Parliament and are appointed by the King on the advice of the Prime Minister. The Prime Minister must command the confidence of majority of the house. The Ministers formulate government policies and they are assisted by general secretaries and various departmental heads in the execution of these policies.

There are three major ethnic groups in Peninsular Malaysia. They are Malays, Chinese, and Indians. The Malays represent about 53 percent of the population, the Chinese about 35 percent and the Indians about 11 percent (Vreeland,1977). In Sabah and Sarawak, the racial composition of the population is even more diverse. Apart from the three ethnic groups mentioned, there are several indigenous groups which together account for about two-thirds of the population.

The indigenous Malays are mostly rural farmers with a small number of them working as civil servants. The second group consists of the Chinese, who not only constitute the second largest ethnic group, but also dominate the economy, monopolize commerce and trade, and

provide a large part of the professional and general labor force. Over 75 percent of the Chinese are urban dwellers.

The third major ethnic group consists of Indians, a term loosely used to cover Pakistanis and Sri Lankans, as well as Indians proper. They form 10 percent of the population and work mostly on the plantations as merchants, money lenders and white-collar workers.

Development of the Malaysian Educational System

The present Malaysian Educational System has been influenced by several factors. First, there was the precolonial era, in which education was primarily religious education (Vreeland, 1977). Second, there was the British intervention era (1809-1949) which passed the British Education System to the Malaysian counterparts that had helped to shape the present policy. These policies encouraged massive Chinese and Indian immigration and the growth of vernacular education. The latter was confined to the primary level, with the exception of the Chinese. Factors contributing to this situation were not clear; probably the chinese were related to the stage of development they were in prior to coming into Malaya. All these resulted in a fragmented educational system, conducted in different languages.

During the colonial period, English education

enjoyed a preferential status. As its availability was restricted, it acted as the prime means to access higher education as well as to prospective employment opportunities and recruitment into the local elite status. The disadvantages of the rural Malay education began to accumulate as these people were confined to their own tradition, norms, and language. Coupled with these they had further setbacks such as lacking access to the accredited and high status English schools and to its relatively slow development of the indigenous Malay education. These factors continued to widen the gap between groups of people.

Third, came the period of post war reconstruction around 1945 to 1956. This period was one of growing nationalism which eventually led Malaya to achieve independence in 1957. Naturally, education was looked upon as a viable tool for the creation of conscientious and responsible citizens.

The post-war period brought about reorganization of the educational system. Specifically, an effort was made to unify the various school programs into one national system. This was done to overcome the negative effects of non-nationalistic feelings resulting from various outside influences, chiefly China, India, and even Britain. For the political leaders at the time, such a negative attitude toward Malaya was politically and socially not

conducive to future development of the country.

In 1956, prior to independence, a major study was done regarding the Malaysian educational system. The report of the study came to be known as the Razak Report. lt called for a major effort to increase enrollment, guaranteed education in the vernacular languages for the three ethnic communities, provided a uniform curriculum for all the streams, and substantially increased financial support for all schools. Free primary education was offered to all those who sought education. Malay and English were made compulsory in all the streams.

ln 1960, a review of the educational policy set out in the Razak Report took place. Its recommendations were duly incorporated in the Education Act of 1961. This Act was comprehensive, and the present system of education is largely the result of its implementation. Its main recommendations included universal free education for all children through the primary level along with the notion that education should be conducted mainly in the medium of Malay and English. This set the trend of unifying attempts by the administration via the nationalizing influence of the language tool.

A major policy change was made again in 1966. On the recommendation of the review board set up in 1965, the selection examination at Standard 6 (grade 6 in the United States) was abolished, and a system of automatic promotion

was instituted through the full 9 years. That meant for the first time provision was made for universal education up to the first three years of secondary education (up to grade 9 in the United States). This definitely brought about a significant increase in enrollment for all schools. The enlarged lower secondary education system resulting from the new policy was known as comprehensive education.

In 1970, another major policy change in the Malaysian educational system took place. All schools formerly taught in English were to be conducted in Malay, which later came to be known as the Malaysian language, for all the subjects. The change in the language of instruction went on, grade by grade, until 1982, at that time, the whole process had been completed through the secondary school level. By then all the schools that had formerly taught in English from Grade 1 through Grade 12, ceased to function. As provided by the Education Act of 1961, facilities for teaching pupils' own language, namely, Chinese and Tamil (Indian language), will be made available in the national school where parents of 15 or more children in a school so request (Wong and Ee, 1971). Also, as provided by the Act, English language will continue to be a compulsory, subject in all schools. As a matter of fact it is a compulsory second language for all students.

Presently in the Malaysian school system there is a 6-year course in the primary schools, 5 years in secondary schools and a further 2 years of pre-university classes (Grade 12 in United States) before the students are eligible to enter the university. There is a public examination held at the end of Grade 9. Having passed this examination the students are streamed (tracked) into the arts, science, technical, and vocational. For tertiary level education, qualified students may enter the teachers' training college, polytechnic, and agricultural college. To enter the university, the students must pass the examination held at the end of the 2nd year of the 6th Form (Grade 12 in the United States). At the primary level, there is only one examination held at the end of Grade 5.

The structure and organization of educational administration in Malaysia are related to the way the country is governed. This may be examined at three levels, namely, federal, state, and school. The institution representing these three levels are respectively the Ministry of Education, the State Education Department, and the individual school.

The Federal Constitution states that education is the responsibility of the Federal Government. As a result, the control and administration of education in Malaysia is centralized. This feature was initiated under the British

rule. In our own context, centralization has the following connotation. Curricula, syllabi, and examinations are uniform throughout the schools, and these are prescribed by the Ministry of Education. Within this uniformity there is, nonetheless, a certain amount of flexibility, with the school principals having sufficient leeway for their own initiative and enterprise. They are free to plan their own schedules and scheme of work as long as they meet the minimum conditions prescribed.

At the head of the Malaysian Educational System there is the Minister of Education who is a member of the cabinet. As a Minister, he is responsible to Parliament for the effective implementation of the educational policy as well as the administration of the entire educational system. He is assisted by two assistant Ministers who are also members of Parliament, a political secretary and a parliamentary secretary. The last two posts are political, and their appointments are at the discretion of the Minister. In order to provide for the smooth running of the ministry, there are two types of permanent officials serving in the Ministry. The first type belongs to the Administrative and Diplomatic Service (ADS). They look after the personnel and the administrative aspects of the organization. The other group of officers constitute those from the education service. They deal with the professional aspects of the Ministry such as school affairs,

curriculum, inspectorate, teacher training, and so on. Support staffs such as secretaries and clerks are also available.

At the State level, the administration of education is the responsibility of the State Director of Education. He heads the education office in the state. As the chief executive officer for the implementation of educational policy in the state, the Director is responsible for the administrative functions relating to registration of teachers and students, examinations, scholarships, staffing, budgeting and the proper management of all the schools in the state.

The principal remains the most important figure in the school. His responsibilities include arrangement of teaching schedules, staff meeting, school administration, and public relations. He is also responsible for setting the tone of the school, channeling its progress, its aspirations, and its discipline.

Any solution to the educational problems facing Malaysia depends also on the economy of the country. Any plans for improvement will come to nothing if the national economy is unhealthy. At present, the main sources of income are rubber and tin with timber coming into prominence. Oil palm and petroleum have also contributed significantly in recent years. Since rubber and tin are subject to price fluctuations in the world market,

Malaysia has recognized this as a problem. Steps have been taken to diversify the economy. At the same time the government is seriously considering the promotion of the growth of industry by creating a climate conducive to domestic and foreign investment. Political stability is part of the climate. To this end, the government has included the expansion of social services, development of industrial estates, and granting of pioneer status to industries, coupled with the introduction of incentives. Without this, it is not certain whether the government could finance the ever-increasing educational budget.

University Technology of Malaysia

University Technology of Malaysia was formed in March 14, 1972. It is situated 4.83 km from the capital Kuala Lumpur. Its area is about 45 acres. Plans have been made to move the present campus to a larger area of 3,000 acres in Skudai, Johore Bahru, the southernmost tip of the peninsula.

At present, University Technology of Malaysia has seven faculties, one institute, and one school. These include: (a) Faculty of Civil Engineering,(b) Faculty of Electrical Engineering, (c) Faculty of Mechanical Engineering (d) Faculty of Chemical Engineering, (e) Faculty of Natural Resources Engineering, (f) Faculty of

Surveying, (g) Faculty of Architecture, (h) Faculty of Science, (i) lnstitute of Computer Science, and (j) the School of Humanities. All the faculties offer courses leading to a diploma and the bachelor's degree. The diploma course of study takes 3 years to complete while the bachelor's degree requires 5 years except for the Bachelor of Architecture which requires 6 years to complete.

Faculty of Science

Science Faculty was officially formed in 1981. Before its official inception it was called the School of Science. The main goal of Science Faculty is to coordinate courses for the Bachelor of Science with education, and to provide services courses for the other faculties in the University. The Science Faculty has five departments. These are: (a) Physics, (b) Chemistry, (c) Mathematics, (d) Science Education and Technical studies, and (e) Education. The faculty is headed by the Dean and three Deputy deans. Each department within a Faculty is headed by a chairman who is directly responsible to the Dean.

Academic Calendar

The year is divided into two halves. The first half

is called July Semester and the second half is called the December Semester. The following is a schedule for the July Semester:

Orientation week	-	1 week
Lecture	-	8 weeks
Mid-semester break	-	1 week
Lecture	-	7 weeks
Study week	-	1 week
Examination	-	2 weeks
Total	-	19 weeks

The December Semester begins after a 4-week break between semesters. The schedule is as follows:

Lecture	-	8 weeks
Mid-semester break	-	1 week
Lecture	-	7 weeks
Study week	-	1 week
Examination	-	2 weeks
Total	-	19 weeks

There is a 10-week leave at the end of the December Semester.

Frequent Testing, Achievement and Test Anxiety

Test Anxiety

Sarason (1959), a major early contributor to theory and research on test anxiety, accurately observed that "we live in a test-conscious, test-giving culture in which the lives of people are in part determined by their test performance" (p. 26). It is therefore not surprising that test anxiety is a pervasive problem on the college campus. Many students are so disturbed by test anxiety that they must seek professional assistance to help them cope with its debilitating effects. Nearly 40 years ago, Brown (1938) called attention to the seriousness of the problem of test anxiety for college students. In commenting on the causes of two student suicides at the University of Chicago, Brown notes that "one of these was definitely due to worry over an approaching examination and the other presumably was . . . . . These incidents show that students are taking their examinations more and more seriously and that the emotional reactions of the students before examinations is an important problem." (Brown, 1938, pp. 11-12).

Since World War 11, psychologists and counselors have become increasingly concerned with understanding the nature of test anxiety and the development of effective

methods for its treatment. It has been repeatedly demonstrated that people who are high in test anxiety experience decrements in performance in evaluative situations. Anxious individuals perceive testing situations as personally threatening and respond to them with intense emotional reactions. Evaluative situations evoke task-irrelevant, self-centered, worry responses that interfere with effective performance on cognitive-intellectual tasks.

Test anxiety is an unpleasant feeling or emotional state that has physiological and behavioral concomitants and that are experienced in formal testing or other evaluative situations (Sarason, 1975, 1978; Spielberger, 1966; Wine, 1971). When test anxiety is experienced, a variety of cognitive and attentional processes are called into play that interfere with effective and successful task performance (Sarason, 1972; Wine, 1971). Current theoretical formulations try to explain the nature and functioning of these cognitive and attentional variables.

The State-Trait Model of Test Anxiety

According to the State-Trait model of test anxiety (Spielberger, 1966), the components of test anxiety may be diagrammed as shown in Figure 3.

Figure 3

The State-Trait Model of Test-Anxiety

(Test stimuli)→(Interpretation of test stimuli)→(A-State Reaction)
↓
(Coping, Avoidance, Defensiveness)←(Cognitive Reappraisal)

Test stimuli are those which the individual associates with evaluation. These may be immediate events, such as a teacher's remark, "We will have a quiz today," or "John, how would you answer that?" Test stimuli may also be related to the future, such as the decision to major in a premedical program with the knowledge that, four years later, one will be faced with MCAT exams and personal interviews at the medical schools. Test stimuli are conditioned stimuli. Their meaning to the individual depends on prior experience. Thus, what is a stimulus of test anxiety for one person may be a neutral event for another.

Interpretation of test stimuli depends on the nature of one's prior experience with these stimuli. They may be perceived as having interesting or positive meaning or as being threatening or neutral. Some individuals can approach evaluation as a positive event. For example, one may approach a test with the mature view that I will either succeed or not in meeting my expectations in this instance, and I will learn and grow from whatever happens.

This is in marked contrast to those whose fear of failure causes them never to set out to achieve, to focus narrowly and intently on one area of achievement at the expense of failing to develop in other areas, or to bungle through challenging tasks. It is important to remember that the interpretation of test stimuli is, by definition, an interpretation based on one's own past history. Thus, fear of failure and other negative interpretations of test stimuli are not fear of failing to carry out the operations required at the time. Rather, these negative interpretations involve "plugging in" to old ideas, such as, "If I fail at this, my life will be less worthwhile," or "I will have fulfilled my father's views that I am not worth anything," or "No one will respect me."

A-State reactions vary depending on interpretations of prior experience and on the nature of the test stimulus. The A-state reaction may consist of heightened arousal, vigilance and a sense of enthusiasm, or it may include fear and worry, confusion, illness, anger, lowering of self-esteem and other negative events.

Cognitive reappraisal refers to the way in which an individual responds to his or her A-state. These responses may be constructive, defensive, avoidant, or a combination of these kinds of responses.

Coping, avoidance and defensiveness refer to the nature of the feelings, approaches and outcomes that may

occur; for example, the task may be successfully or unsuccessfully completed. It may be consciously and confidently addressed, fearfully approached, avoided or blundered through. The nature of one's performance may be fully acknowledged, denied, or blamed on someone else. The individual may feel good, bad, unaware, or indifferent about the task and the performance.

As this general model in Figure 3 suggests, there are adaptive test anxiety processes that healthy people experience everyday, and there are maladaptive processes to which we refer when we speak of high anxiety. People who experience high anxiety in test situations are very sensitive to cues that suggest the imminence of testing and interpret testing situations as a serious threat to their well-being. The resulting A-state response is a powerful, unpleasant, and disruptive emotional reaction. The cognitive reappraisal typically involves considering a number of uncontructive ways to deal with the test and the anxiety. The coping behaviors followed are less constructive and effective than is desirable and may be accomplished by defensive and avoidant behavior.

Thus, we must distinguish between two meanings of the term, test anxiety, anxiety as a state and anxiety as trait (Spielberger, 1966). State anxiety is a transitory state that occurs when an individual perceives stimuli of (real or imagined) test and responds with certain emotions

and behavior. Trait anxiety refers to a relatively stable personality characteristic, the disposition to perceive as threatening a wide range of the stimuli that are associated with tests and the tendency to respond to these with extreme A-state reactions.

Evaluation situations that threaten self-esteem evoke higher levels of A-state response in high A-trait individuals than low A-trait individual. Differential level of A-state reaction is related to level of performance in intellectual tasks (Hodges, 1968). In contrast, physical danger does not evoke such differential A-state responses; rather, it evokes a similar increase in A-state for high and low A-trait persons (Lamb,1969).

Theories of the Effects of Test Anxiety

The generally accepted current explanation of the negative effects of test anxiety is that ineffective cognitive strategies and attentional deficits cause poor task performance. Children with low level of anxiety appear to become deeply involved in evaluative tasks, but highly anxious children do not. Highly anxious children seem to experience attentional blocks, extreme concern with autonomic and emotional self-cues, and cognitive deficits such as misinterpretation of information (Sarason, 1978; Wine, 1971). The highly anxious child's atten-

tional and cognitive deficits are likely to interfere with learning and responding in evaluative situations and result in lowered performance.

The conceptualizations suggest the importance of cognitive factors as mediating influences in the effects of test anxiety on children's learning and performance. These cognitive factors influence the perception of a situation as evaluative or not (Sarason, 1978). The cognitive activities considered important in the mediation of test anxiety are generally conceptualized as attentional in nature (Sarason, 1975, 1978; Wine, 1871). These mechanisms influence stimulus reception and interpretation as well as overt behavior (Sarason, 1975, 1978). Hence, attention deficits in high-anxious individuals has been a major concern in testing or evaluative situation.

Some researchers (e.g., Liebert & Morris, 1967; Morris & Liebert, 1970) have examined the highly anxious person's attention to self-stimuli as opposed to task stimuli. Worry is conceptualized as cognitive concern over performance in a task; emotionality is viewed as an automatic arousal aspect of test anxiety. The adverse effects of test anxiety are presumed to be the result of a division of attention between concern over task performance, on the one hand, and the physiological aspects of arousal, on the other hand. The highly anxious person attends more to the autonomic aspects of arousal and less

to the task than does the person with low anxiety. This division of attention results in poorer test performance for persons than persons who are less anxious. The primary concept from this perspective is worry, because it results in a cognitive concern about one's ability relative to others and about the consequences of failure. This concern replaces attending to and working at the task at hand.

Worry is defined as cognitive concern over task performance, and emotionality as the autonomic arousal aspect of anxiety. Morris and Liebert (1970) indicate that worry is the more stable, enduring component of test anxiety; whereas, self-report of emotionality has a more transient quality and is confined to evaluating situations. Worry affects cognitive performance and performance expectations. Emotionality does not relate consistently to these variables. Thus it is the cognitive, self-preoccupied worry component of test anxiety that interferes most directly with task performance. The higher self-reported levels of emotionality on the part of highly anxious persons also probably reflect greater attention to internal events as opposed to externally directed, task-focussed attention.

According to attentional theory, it should be possible to negate the deleterious effects of test anxiety by helping the child focus attention more directly on the task (Dusek, Kermis, Mergler, 1975; Dusek, Mergler &

Kermis, 1976; Wine, 1971). Research also indicates that providing task-relevant strategies helps highly anxious children better attend to evaluative tasks and improve their performance. Other research (Sarason, 1972) indicates that providing task-oriented instructions, cues about expected performance, task-effective models, and memory supports facilitates the performance of highly anxious persons in evaluative situations.

As described previously, the cognitive and attentional deficits associated with high test anxiety are partly the result of parental and other adult reactions to the child's success and failure in evaluative situations. Hill (1972) has placed special emphasis on the developing child's success and failure experience in explaining why some children become highly test-anxious. Children with low test anxiety generally have a history of success in school and other evaluative situations and experience generally positive interactions with adults in evaluative settings. As a result, they develop a relatively higher motivation toward success and learn to rely on their own evaluations of performance for guidance in problem solving (Hill, 1972). Since highly anxious children have a generally poorer history of success in school and other evaluative situations and have experienced somewhat more punitive interactions with evaluative adults both parents and teachers, they develop problem-solving strategies that

indicate motivation to avoid failure and criticism rather than to approach success. Highly anxious children, then, are apt to develop a high dependence on adults for evaluation of their performance and for direction in problem solving.

The relation between success and failure experiences and scores on the Test Anxiety Scale for Children (TASC) were directly measured by Bradshaw and Gaudry (1968). They divided the 90 ninth graders into three groups: a control group, a group that experienced success on a multiple choice vocabulary test, and a group that experienced failure on a multiple choice vocabulary test. Success and failure were manipulated by making the tests easy or hard. The test for the control group included both easy and hard items. Each test contained 40 questions which were to be answered in 5 minutes. After taking the test, the students graded it, compared their scores to a standard (30 or more was very good, 20 or less was poor), and then took the TASC. The findings showed that children who experienced failure on the vocabulary test scored higher on the TASC than those who experienced success. This result was especially pronounced for children in the lower stream. The results of this study indicated that histories of success and failure are important determinants in the development of test anxiety.

Further evidence in support of Hill's theory of the

relation between success and failure experiences and test anxiety comes from the study of children's performance on mathematics problems (Hill & Eaton, 1977). Sixty fifth and sixth graders were divided into groups of high, middle, and low anxiety on the basis of their TASC scores. Half the children were given a series of mathematics problems that were easy to do, and the children experienced success doing them. Half the children were in a mixed success/failure condition in which one-third of the problems were fairly difficult and two-third were easy. One-third of the problems in each set were identical to allow comparisons of the performance of the three groups of children. All children were told that if a bell rang while they were working on a problem they were to put it aside and start on a new problem. For subjects in the mixed success/failure condition, the experimenter rang the bell on the difficult problems, causing the children to fail to complete approximately one-third of the problems they attempted. The dependent variables were (a) average time to complete a problem, (b) accuracy (errors), and (c) cheating (working after the bell had rung, skipping a problem or returning to a previous problem).

In support of Hill's theory, the highly anxious children in the success/failure condition took somewhat longer to complete the problems, were less accurate, and cheated somewhat more than less anxious children. In the

success condition, the performance of the highly anxious children nearly matched that of their less anxious counterparts. These results indicate not only that failure experiences are related to the highly anxious child's poorer performance in evaluative situations, but also that providing highly anxious children with success and nonevaluative testing conditions, can increase their performance because it allows their motivation for achievement to operate more strongly than their motivation for failure. The data also indicate that the relatively poorer performance of highly anxious children does not represent a learning ability deficit relative to their low-anxious peers. In the success condition, the highly anxious children went as fast and were as accurate as less anxious children. According to Hill (1977), differences in the performance of less anxious and highly anxious children in the failure situation were the result of motivational factors.

By altering situational characteristics, for example, providing success experiences, nonevaluative instructions and procedures, and the like, one can obtain a more accurate estimate of the learning and achievement of highly anxious children (Hill & Eaton, 1977).

The reviewed research shows that the highly anxious child's history of failure leads the child to rely on external supports in evaluative situations. When these

supports are lacking the highly anxious child suffers cognitive and attentional deficits that result in poorer task performance than would be obtained in nonevaluative situations.

Measuring Test Anxiety

A number of questionnaires have been developed to measure test anxiety. These include the following:

1. Test Anxiety Questionnaires (Mandler & Sarason, 1952),
2. Test Anxiety Scale (Sarason, 1978),
3. Worry and Emotionality Questionnaire (Morris & Liebert, 1968),
4. Achievement Anxiety Test (Alpert & Haber, 1960), and
5. State Trait Anxiety Inventory.

These five measures of test anxiety are described in the following paragraphs.

Test Anxiety Questionnaires

The Test Anxiety Questionnaire (TAQ) was developed by Mandler & Sarason in 1952 at Yale University. One hundred and fifty-four students in an introductory

psychology course at Yale University were given an anxiety questionnaire. The questionnaire was presented to the students as a questionnaire on attitudes toward test situations. It consisted of 67 questions (42 anxiety questions and 25 attitude questions).

The anxiety questions dealt with a student's subjective experiences in the testing situation such as uneasiness, accelerated heartbeat, perspiration, emotional interference and worry before and during a testing session. The questionnaire also contained questions relating to attitudes (like and dislike) toward tests. The subjects were requested to mark their answers for each question anywhere along a 15-cm graphic scale with endpoints and midpoints indicated. Only sophomores and juniors who completed the questionnaires were included in the study. The resulting 101 questionnaires were then scored by assigning a score expressed in millimeters to each question. The resulting 101 scores for each question were then tabulated and a subject was given a score of 0 if he or she fell below, and score of 1 if he or she fell above the group median. A total score of each subject based on the 0 and 1 scores was then determined for 42 anxiety questions and 25 attitude questions. For the purpose of this study only the anxiety scores were used. The distribution of each of the 42 questions was then compared with the distribution based on all 42 questions.

For this purpose the subjects were divided into two groups at the total score median and the consistency with which each of the 42 questions divided the subjects into these two groups was determined by chi-square. All questions which divided subjects on this basis at better than chance expectancy (at the 0.03 level of confidence) were retained. Five questions did not fulfill this condition and were discarded. From the remaining 37 questions each subject obtained a revised score theoretically ranging 0 to 37. The split-half reliability (odd vs. even questions) of the anxiety questionnaire was 0.91 (Spearman Brown).

Test Anxiety Scale

In 1958, Sarason, developed his Test Anxiety Scale (TAS) consisting of a 21-item, true-false test. As a result of factor and item analysis, the TAS has undergone a number of revisions, and the final version consists of 37 items. The longer scale was developed to increase sensitivity and reliability.

Test retest reliability over 0.80 was obtained for an interval of several weeks. Wagaman, Cormier, and Cormier (1975) reported a test-retest reliability coefficient of 0.87. Table 2 shows the means, medians, standard deviations, and ranges for the distribution for 283 male and 237 female undergraduates at the University of

Washington. A score of greater than 22 (out of 37) is considered high.

Table 2

means, medians, standard deviations of TAS score

	male	female
mean	16.72	19.74
median	15.72	19.15
standard deviation	7.12	6.73
range	3-35	3-37

Table 2 demonstrates that female students have a slightly higher anxiety than male students.

Worry-Emotionality Inventory

Two separate self-reports have been developed to measure the worry and emotionality components of test anxiety. One is the 10-item Worry-Emotionality Inventory (Liebert & Morris, 1967). The other is the 16-item Inventory of Test Anxiety (Osterhouse, 1972).

The items were developed from items on the Sarason and Madler Test Anxiety Questionnaire (1952). The items are rated on a scale of 1 to 5 indicating how much the feeling, state or condition applies to the person. The range of scores on each subscale thus varies from 5 to 25 with increasing scores indicating more worry or emotional-

ity.

The Inventory of Test Anxiety was constructed in a manner similar to that of the Liebert-Morris scale. The 10 items from the Liebert-Morris scale were pooled with 11 others drawn from various test-anxiety scales. Osterhouse then employed a similar interjudge procedure and eliminated five items, resulting in an eight-item instrument. Each item is rated on the same 1 to 5 scale so that scores range from 8 to 40 with larger score indicating greater worry or emotionality.

The two short scales appear to have moderately high reliability. For the inventory of Test Anxiety, split-half reliability was reported as 0.92 (Osterhouse, 1972), and test-retest reliabilities over a 7-week period in a college classroom were found to be 0.68 for emotionality and 0.72 for worry (Osipow & Kreinbring, 1971). Alpha coefficients for the Liebert-Morris scale were reported as 0.83 and 0.76 for emotionality and 0.68 and 0.69 for worry. The responses of 654 males and 795 females were used in the study (Morris & Liebert, 1970).

Achievement Anxiety Test

Alpert and Haber (1960) constructed the Achievement Anxiety Test (AAT) to identify individuals whose academic performance was facilitated by the stress of the test

situation, as well as those whose performance was impaired. The AAT consists of two scales, a 9-item facilitating anxiety scale (AAT+) and a 10-item debilitating anxiety scale (AAT-). The 19-items of AAT were chosen from a larger pool of items on the basis of their ability to predict the grade point average of college students. Each item was scored on a 5-point scale from 1 to 5.

As Alpert and Haber pointed out that in the construction of the TASC and TAQ, it was implicitly assumed that if a subject had a great deal of debilitating anxiety, he would have little or no facilitating anxiety. This view assumed that there was a high negative correlation between debilitating and facilitating anxiety. In contrast, Alpert and Haber maintained that an individual may possess a large amount of both anxieties or one but not the other, or none of either. In other words, facilitating and debilitating anxiety may be uncorrelated. This research attempted to demonstrate that facilitating anxiety was not just a mirror image of debilitating anxiety but does, in fact, add a new element. The test-retest reliabilities for a 10-week interval were reported as 0.83 and 0.87, respectively. The test-retest reliability over on 8-month period was found to be 0.75 for the facilitating scale and 0.76 for the debilitating scale. The two scales were administered in one questionnaire, the items randomly mixed. A total of 379 students were used in

the study.

Alpert and Haber (1960) gave the mean score for AAT+ as 27.28 with a standard deviation of 4.27, and the mean score for AAT- as 26.33 with a standard deviation of 5.33. An AAT+ score of less than 23.01 was considered as a low facilitating score and an AAT+ score of greater than 31.55 was considered as a high facilitating score. An AAT- score of less 21.00 was considered as a low debilitating score while an AAT- score of greater than 31.66 was considered as a high debilitating score.

State-Trait Anxiety Inventory

The State Trait Anxiety Inventory (STAI) is by far the most widely used measure of one of mankind's most pervasive questions. Traditionally, anxiety has been viewed as having two distinct forms. The state form of anxiety consists of the transitory feelings of fear or worry, which most of us experience from time to time. The trait form of anxiety is the relatively stable tendency of an individual to respond anxiously to a stressful situation. The STAI is a 40-item measure which provides information about a person's levels of state and trait anxiety. The construction of the STAI by Charles Spielberger and his colleagues began in 1964 and was published in 1970.

The STAI were designed for high school and college students and for adults, but all of the items were written below the sixth-grade reading level. As a result, the test could also be used with junior high school students. Developed as a self-administered test, the STAI may be given either individually or in groups. Although there is no time limit, most subjects will complete both scales in less than 10 minutes.

When the full 40-item STAI is administered, as recommended in the manual, two scores will be obtained. One score will reflect the person's current level of state anxiety and can range from 20 to 80 with higher scores reflecting more anxiety. The other score indicates the person's general level of trait anxiety and also can range from 20 to 80 with higher scores indicating more anxiety.

Scoring the STAI is also straightforward. A subject's score on each scale is simply the sum of the responses to the 20 items on that scale. The only complication is that the responses to the 10 anxiety-absent items on the State-Anxiety Scale and the 9 anxiety-absent items on the Trait-Anxiety Scales need to be identified (e.g., 1 - 4,etc.) before they are summed.

The interval consistency of the Trait-Anxiety Scale, ranged from 0.89 to 0.91 across male and female samples of working adults, military recruits, and college and high school students. For the State-Anxiety Scale this

range was from 0.86 to 0.95. This reliability was measured using samples of 202 male and 22 female high school students and 1728 Air Force recruits (Chaplin, 1984).

Test Anxiety and Examination Performance

The study of test anxiety was started by Madler and Sarason (1952) now famous investigators of anxiety and learning. Sarason and Madler believed that the testing situation evokes both learned task drives and learned anxiety drives. Some of the anxiety drives are task relevant while others are task irrelevant. The learned task drives and the task-relevant anxiety drives facilitate test performance, while the task-irrelevant anxiety drives decrease test performance. The task-irrelevant anxiety is suffered by the highly anxious person during examination, resulting in a lowered performance.

The anxious student is commonly described as one who knows the course material but, because of anxiety, is unable to demonstrate his or her knowledge on an examination (Paul and Eriksen, 1964). Therefore, a significant inverse relationship between test anxiety scores and examination scores is expected.

Sarason, (1957) conducted a study to find the relationship between test anxiety, general anxiety, and intellectual performance of 305 liberal arts under-

graduates at Yale University. Most of the subjects were administered the Test Anxiety Questionnaire (TAQ) and the General Anxiety Questionnaire (GAQ). He found that TAQ scores tended to correlate negatively with measures of academic achievement, although with increase in number of years in college the negative correlation disappeared. Highly anxious subjects performed at a significantly lower level than did less anxious subjects.

Doctor and Altman (1969) conducted a study to find the correlation between worry and emotionality test anxiety. Their subjects were 159 sophomores in a general psychology course at the University of Kentucky. The subjects were tested with the Test Anxiety lnventory developed by Liebert and Morris (1968), before and after the final examination. Results of their findings showed that emotionality scores dropped significantly following completion of the examination irrespective of initial level of test anxiety or performance expectancy. As hypothesized, worry was more highly correlated with expectancy of success ratings than emotionality, but the prediction that worry scores would not change following the examination was replicated only for the relatively less worried subjects. Highly worried subjects evidenced significant decrements in pre- to post-examination assessments of worry, suggesting that these scores had, perhaps, been incremented by the perceived aversion to the

test-taking situation. The worry component of test anxiety was more highly associated with actual performance on the final examination than emotionality with highly worried subjects performing significantly poorer than less worried subjects. Emotionality level was relatively low. It was pointed out that differential changes in worry at the high and low values of this variable had not been observed in previous studies (Spiegler, Morris & Liebert, 1968).

Deffenbacher (1977) did a study to find the relationship between worry and emotionality to performance on the Miller Analogies test using students at the University of Oregon. In the experiment 52 males and 27 females completed the Worry-Emotionality Inventory just prior to taking the Miller Analogies Test. Worry and emotionality were significantly correlated ($r = 0.69$). State test anxiety, worry, and emotionality were inversely related to performance, but partial correlations indicated that only worry was correlated with performance when the common variance between worry and emotionality was partialled out. Highly worried students performed less well than less worried students. The effects of emotionality were nested within worry levels. At low levels of worry, emotionality was unrelated to performance, but at high levels of worry, high emotionality was associated most negatively with performance. That is, the negative effects of emotionality were nested within the upper range

of worry. No sex differences were found. The results were interpreted as supporting the conceptual distinction between worry and emotionality. Similarly, Spielberger et al. (1978) found a negative correlation between grade point average and worry scale of the test anxiety inventory.

Galasi et al. (1981) conducted a study to find the relationship between test anxiety and test performance at various moments during an actual course examination. A 3 X 2 X 3 (test anxiety level X level of past academic performance X point of assessment) factorial design was employed to examine effects on the following eight dependent variables: (a) positive thoughts, (b) negative thoughts, (c) evaluation, (d) potency, (e) activity semantic differentials, (f) history test grade, (g) bodily sensations, and (h) subjective units of disturbance scores. The sample consisted of 231 undergraduates at the University of North Carolina at Chapel Hill who were enrolled in a large history class. The results showed that highly anxious students had significantly fewer positive thoughts than less anxious students and the highly anxious students had more negative thoughts than low anxious students. As test anxiety increased, evaluations of tests became correspondingly and significantly more negative. In addition, less anxious students viewed tests as significantly less potent and less active than did highly

anxious students. The level of test anxiety was also a significant influence on a student's cognitive structures (learning systems) concerning academic tests, their behavioral outcomes, and their subjective tests were less negative, less potent and less active experiences for less anxious students. In addition, less anxious students achieved higher test grades and experienced lower Subjective Unit of Disturbance Scale(SUDS) levels or fewer bodily sensations indicative of arousal.

Hunsley (1985) studied the impact of test anxiety on test performance and the cognitive appraisals of students experiencing test anxiety. The subjects were undergraduates enrolled in a second year psychology statistics course at the University of Waterloo, Ontario, Canada. The subjects, 62 students, were given multiple examinations. Two weeks before their first course examination, the subjects completed a test anxiety measure. Then the subjects were assessed immediately before and after each of four examinations on state anxiety and cognitive appraisals measures. The debilitating anxiety scale of the Anxiety Achievement Test (Alpert & Haber, 1960) served as the dispositional measure of test anxiety. State anxiety measures consisted of the State Anxiety form of the State-Trait Anxiety lnventory and the Subjective Units of Distress Scale (SUDS). All cognitive appraisal questions required subjects to respond on an 11-point scale from 0

to 100. Results of the findings showed that test-anxious students obtained lower examination grades than did their non anxious counterparts.

In summary, the research on test anxiety and examination performance supports the position that test anxiety consists of two components, worry and emotionality. Further evidences (Deffenbacher, 1977) shows that high worry is the concern and effect causing poor performance of students in evaluative measures. The research suggests that highly anxious students perform poorly as compared with less anxious students on evaluative measures. Most of these studies were in liberal arts and none in science. It has also been criticized that most of the studies are poor and the instruments can be easily falsified. So these studies leave some doubt as to their validity. In spite of the criticisms, many studies have shown the same results. Knowing the negative effects of test anxiety in evaluative measures, suggests the concern of neutralizing them in the complex school system? Almost every facet of school curriculum requires an evaluation. In fact, evaluation is a part of the teaching and learning process (Grondlund, 1985). As mentioned earlier in the theory of test anxiety, the negative effects of test anxiety can be lessened if evaluations measures are not stressed. Wine (1979) made several suggestions for altering the evaluative character of the school, include:

. The teacher's role should be redefined. Rather than the traditional heavily evaluative character of the teacher's interactions with children, a shift is proposed to a task-oriented, information-giving role model, showing excitement and involvement in specific subject matter.

. Feedback to the subjects must be informative, immediate, and directed to specific tasks rather than global.

. The teacher, as a social-evaluative figure, should remove himself or herself as much as possible from the test-anxious child's environment.

. Task materials should be made as interesting and engaging as possible and should be presented with task-oriented, curiosity- and attention-eliciting instructions, with a minimal evaluative component.

With better understanding of the relationship between test anxiety and evaluative measure, teachers and teacher educators should be able to reduce student anxiety and improve students evaluative performances.

Effects of Frequency of Testing on Achievement and Test Anxiety

Research on the effects of frequency of testing on achievement was started in the early thirties. In 1934, Kulp gave a class of 32 students in an educational

sociology course a 10-minute objective examination each week for the first half of the course. The purpose of Kulp's study was to determine whether frequent testing would aid learning for a group of mature graduate students. Students who showed above average standing at mid-semester were classified as the upper half and were excused from such tests for the remainder of the semester. The rest of the students, classified as the lower half, continued the weekly 10-minute objective tests. The superiority of the upper half over the lower half, which amounted to 39 points higher at mid-semester, fell on the final examination to only five points higher. Kulp concluded from the results that weekly testing did increase the amount of learning accomplished by upper and lower students. That is, both groups of students profited from taking the weekly examinations.

In 1939, Victor Noll reported a study in which he had given tests to one group at various intervals throughout the semester and had not given periodic tests to another group. The subjects of the experiment comprised two classes in educational psychology for two consecutive years. One class during 1 year was given periodic examinations. To the other class during the following year, he did not give periodic examinations. Achievement was measured in both classes by the same 1-hour objective midterm examination, and a 2-hour objective final examina-

tion. In the experimental class, four quizzes were given at approximately 3-week intervals. In the control class, no quizzes or tests were given other than the midterm and final examinations. The quizzes for the experimental group varied in length and were essay and objective. All quizzes were checked by the instructor and returned to the students, and an opportunity was provided for discussion and answering questions if the student desired it. The course for both groups was presented in exactly the same way. Neither group was told of the experiment. Individuals in the control and experimental groups were matched on percentile rank on the American Psychology Test. The results of the study reported by Noll indicated that students in the group where no quizzes were used, other than the midterm and final examination, showed a consistently though not substantial, higher average achievement than was shown by students in the group where occasional written quizzes were given.

In Noll's study, the experimental group was comprised of a class of one year, while the control group was comprised of a class the following year. Noll stated that both classes were administered the same mid-semester and final examinations. Noll added that the students in the control group may have had access to the examination via the students in experimental group. If so, this may have contributed to the control group demonstrating higher

average achievement.

Fitch, Drucker, and Norton (1951) investigated the effects of frequent testing upon the achievement of college students in a lecture course on government. The control group was comprised of a class of 97 students to whom only regular monthly quizzes were given. The experimental group was made up of another class of 198 students to whom weekly quizzes were administered in addition to the regular monthly quizzes. Both groups were treated the same and taught by the same instructor. No knowledge of the study was revealed to the students.

The criterion variable for evaluating the results of the study was based on the grade assigned in five 1-hour objective tests given in both experimental and control sections and jointly graded for both sections. Fitch, Drucker, and Norton stated that the fact that there were variations in discussion session attendance had to be taken into account. They used a four-by-two table of eight cells. Four classes on the vertical axis represented the four groupings of discussion attendance frequency, and two classes on horizontal axis represented membership in the control and experimental group. Analysis of covariance was used to statistically analyze the data.

The investigators reported that their results indicated that frequently tested students had significantly higher achievement than students who received only

monthly quizzes, even after a predetermining index of ability in the subject matter had been partialled out. The investigators claimed that the frequently tested students seemed to attend more discussion sessions. They further concluded that frequent testing in college classroom may result in superior achievement. Fitch, Drucker, and Norton not only introduced differences in test frequency, but they also allowed differences in the time allocated to testing and in the nature and extent of the review.

In 1962, Selakovich did a study to determine the effectiveness of frequent testing as an aid to learning in a course on American National Government taught at West Texas State College. He found no significant differences between treatment groups. Selakovich used 12 "pop" quizzes of the objective type for his experimental groups and gave no quizzes to his control groups. Three essay examinations and the cooperative school and college ability test served as criterion instruments for his study.

A study by Pikunas and Mazzota (1965) indicated that frequent testing during a semester increased student learning in science. The investigators compared the effects of weekly testing with no testing over two, 6-week periods in chemistry classes of 128 high school seniors. Four classes were divided into two groups chosen randomly. One group covered one set of six chapters (set A) and another group covered another set of six chapters (set B).

At the end of 6-week period, both groups received an examination as a criterion of learning efficiency. The examination was taken from test booklets issued by a textbook publisher. The investigators stated that the subjects were not informed that they were taking part in an experimental study. Their results indicated higher scores for the group receiving weekly tests. However, the statistical significance of the differences was reported. Pikunas and Mazzota concluded that the use of a weekly testing program significantly improved the final examination scores in chemistry.

One feature of the experimental design of Pikunas and Mazzota casts doubt on whether they were measuring the effects of test frequency. Each group had met for three 68-minute periods per week. The experimental group had one lecture class period, one test period, and a third period devoted to grading and reviewing tests. The control group had one lecture class, but the remaining time was spent in private study, recitation concerning homework, and question- and-answer sessions. This aspect of the design raises the question as to whether or not test frequency was the only variable being manipulated.

Marso (1970) conducted a study to find the effect of classroom testing procedures and test anxiety on achievement. The subjects were 116 students enrolled in four sections of an introductory educational psychology

course taught by the researcher at the University of Nebraska. The subjects were assigned to 16 experimental groups in which the following conditions were produced:

Test feedback. Each of the four classes was randomly assigned to one of two test feedback categories: feedback or no-feedback conditions. Subjects in the two feedback classes were presented with the correct responses to the test items and were allowed to discuss the items. Subjects in the two no -feedback classes were provided with their letter grade for each unit test, but were not provided with a discussion of the test items.

Test frequency. The four class sections were randomly assigned to two test frequency categories. Subjects in two class sections were given six, 28-item unit examinations while subjects in the other two class sections were given three, 56-item unit examinations during the course.

Grading of a unit tests. Subjects within each of the classes were randomly assigned to two grading conditions.

Subjects assigned to an ungraded condition were informed that they were required to take the unit tests but that they would take the tests only for learning purposes as the unit examinations would not be graded.

Test anxiety. Subjects within each class were assigned to two levels of test anxiety on the basis of

their scores on a measure of test anxiety.

A 2 X 2 X 2 X 2 analysis of covariance unequal cell-size was used in the study. The findings indicated that subjects taking six unit tests scored higher on this post- test than did those students taking three unit tests. Also, subjects with low test anxiety scored higher on this post-test than did subjects with high test anxiety. Subjects exposed to unit test feedback scored higher on the post-test than did subjects in the no-feedback condition and subjects classified as having high test anxiety did not perform as well on this criterion measure. The study also showed that the grading of unit tests positively influenced student achievement even though the gains were small and possibly temporary in nature.

In 1971, Monk and Stallings conducted an experiment to investigate the relationship between frequency of testing and learning. The subjects were 164 college students in two equivalent introductory physical geography courses. The students attended two lectures per week in one of the two classes taught by the same instructor. In addition, they attended one of the eight quiz-discussion sessions, each of which met 1-hour, 3 days a week. In designing the experiment Monk and Stallings stated that they assumed that both classes could be regarded as equivalent with respect to student ability and prior

knowledge of the subject matter. Assignment of subjects to treatment was considered random by the investigators. They stated that possible effects of teacher variance were controlled by designating one of the classes taught by each assistant as an experimental group and the other as a control group. They claimed that they gave an equal number of test items to each group and covered the same material on the tests for each group. The control group was administered four, 30-item quizzes at approximately monthly intervals. The experimental group was administered several 15-item quizzes at approximately weekly intervals. Both groups were administered two, 1-hour examinations and a final examination in addition to the above testing schedule. The two, 1-hour examinations, which consisted of 200 items, served as criterion instruments for the experiment. The questions were true-false, multiple choice, and short answer with a similar balance of item types for both groups. The criterion tests were similar in style to that of the class quizzes. Quizzes were returned to the students after 1 week.

Monk and Stalling reported that the results of their experiment suggested that moderate variations (weekly vs. monthly) in test frequency did not significantly affect the college student's learning as measured by criteria which were similar to class quizzes.

Stokes, (1973) did a study on the effects of

frequent testing on achievement and test anxiety. The subjects were of 46 students enrolled in general chemistry at the University of Missouri, Kansas City. The subjects were randomly assigned to constitute the 25 subjects for the experimental group and 21 subjects for the control group. All subjects were assigned to subgroups (high or low ability) according to their scores on the American Chemical Society-National Science Teachers Association (ACS-NSTC) examinations used as a pretest. All subjects collectively attended the same lecture classes at the same time, covered the same specified subject matter, and were subjected to the same learning experiences, with the exception of the testing method employed. The experimental group was subjected to frequent testing of seven or more tests while the control group had four tests. The results of the study showed the following:

. The experimental group did not achieve more than the control group.

. The low ability students from the frequent testing showed greater achievement than the low ability students from infrequent testing in general chemistry.

. The high ability students did not show any significant gains in achievement in either groups as a result of frequent testing.

. Students tested conventionally demonstrated, to a significantly greater degree, a specific form of maladap-

tive anxiety than did students tested frequently.

Sumprer and Hollandsworth (1982) investigated the differential effects of weekly tests versus a single midterm examination on measures of state anxiety, task-irrelevant thinking during testing, and test performance. Subjects consisted of 28 students, 4 males and 24 females, enrolled in an undergraduate course on group procedures at a large south eastern university. Subjects were matched by pairs according to pre-treatment, differences scores (debilitative minus facilitative score) on the Achievement Anxiety Test (AAT) and randomly assigned to one of two treatment groups. The weekly multiple-choice tests were based on course material.The midterm conditions consisted of the same 50 items presented in identical order during one administration at the end of a 5-week period. One month after the term, an unannounced, four-question essay examination on the same material was administered to determine the effects of the testing conditions on long-term retention. Results of the study showed that the weekly test conditions resulted in significantly lower levels of state anxiety and task-irrelevant thinking. Also, it was reported that the test scores for the weekly test condition were on the average a half-letter grade higher than those in the midterm-only group.

Lemahiau (1984) studied the effects and instructional content of a program of student monitoring through

frequent testing on achievement. The intent of the study, Monitoring Achievement in Pittsburgh (MAP), was to employ curriculum bound tests in the frequent assessment of student progress so that the resultant data would aid teachers in establishing and focusing instructional goals and objectives. The broad activity in the development of the MAP project was the reaction of monitoring instruments. The Program required the periodic assessment, every 6-weeks, of each student during the regular instructional period in mathematics. The tests were scored by the district. Results were returned to the teacher in timely fashion and in a form intended to be useful in reviewing and tailoring classroom instruction. This study was carried out on the entire population of approximately 2800 students in Grades 2, 5 and 8, so any test of significance of these results was considered unnecessary. There was no parent population to extend to statistical influences. Any observed results are real. They did not capitalize on chance (Lemahieu, 1984). Results of the study showed that in all three grades were increases in performance levels. The greater focusing at the upper grades tended to increase performance.

Summary

From the studies reported of frequently tested

groups versus nonfrequently tested groups, the majority of the studies indicated that frequently tested groups scored significantly higher in achievement than the infrequently tested groups. The studies also indicated that the lower ability, frequently tested groups scored significantly higher in achievement than the infrequently tested, low ability groups.

On the question of test anxiety, four out of five studies reported that test anxiety was lower in the frequently tested group.

It is clear from the studies that the students performed well in a frequently tested environment. However, the research designs in many cases were questionable. As a result, the findings could cause some doubt. Assuming the results were valid, the question arises as to how to apply these results to the school system. By implementing frequent testing, more questions have to be prepared, requiring more teacher effort and time. A possible solution to the problem might be formation of smaller classes, and increasing the use of computers, especially for reporting and grading.

The studies indicate that more research should be done in the area of science teaching, as most of the studies reported are in psychology or humanities.

Frequent Testing and Attitudes Toward Science

Attitudes Toward Science

Science educators and teachers of science unanimously agree on the development of attitudes as a goal for science teaching. The development of attitudes includes both the development of scientific attitudes and attitudes toward science (Ramsey and Howe, 1969). Attitudes toward science refer to the feelings, opinions, beliefs in and about, and appreciations which individuals have formed as a result of interacting directly or indirectly with various aspects of the scientific enterprise, and which exert a directive influence on their behaviors toward science (Allport, 1967).

The development of favorable attitudes toward science and scientists is considered important for two main reasons. First, the attitudes, which an individual has, influence to a considerable degree his or her learning of science and use of scientific information. Second, the possession of favorable attitudes toward science is an important characteristic of a scientifically literate person (NASTA, 1968; Wood, Pella and O'Hearn, 1968). Science teaching, as Hurd (1968) asserts, must result in scientifically literate citizens if it is to meet effectively the challenging demands of change.

Differences between Attitudes Toward Science And Scientific Attitude

Gauld and Hukins (1980) mentioned that there is a lack of agreement about the meanings of various terms, including the terms "scientific attitudes" and "attitudes toward science."

The term "attitude" is a broad one, and even when it is used in discussions about science education, the term can take on different meanings. It is possible to distinguish two broad categories: attitudes toward science (e.g., interest in science and attitudes toward scientists; and attitudes toward social responsibility in science) and scientific attitudes (e.g., open-mindedness, honesty, skepticism). In the first category, there is always some distinct attitude object, such as science and scientific to which the respondent is invited to react favorably or unfavorably. In the second category, this description is inapplicable: traits such as open-mindedness and honesty are better described as styles of thinking which scientists are presumed to display (Gardner, 1975).

Since the meaning of the two concepts of attitude has not been agreed upon, it seems necessary to find the consensus of those who have used these terms. Another reason to distinguish between these terms is that it may

be possible for a student to like science but yet not have "scientist-like" thinking patterns (Stead et al., 1979).

Attitudes Toward Science

The term "attitudes toward science" is used to indicate how an individual feels and thinks about science and scientists as a result of interacting directly or indirectly with various aspects of the scientific enterprise and which exert a directive influence on his behavior toward science (Ramsey & Have, 1969; Hassan & Bileh, 1975). Thus attitudes toward science reflect the individual's opinions and dispositional reactions to the scientific enterprise: its significance and utility to individuals and societies; the comprehensibility and reliability of the claims (in both knowledge and methodology).

Koballa and Growley (1985) stated that there is now widespread consensus that the term "attitudes toward science" should be used to refer to a general and enduring positive or negative feeling about science. It should not be compared with scientific attitude, which may be aptly labeled scientific attributes (e.g., suspended judgment and critical thinking). "I like science," "I hate science," and "Science is horrible," are considered to be expressions of attitudes toward science because they

denote a general positive or negative feeling toward the formal study of science or science as an area of research.

Gordon Allport (1967) in the original Handbook of Social Psychology said that the concept attitudes toward science has become important for a number of reasons. First, attitudes towards science are thought to fulfill basic psychological needs, such as the need to know and the need to succeed. Second, attitudes toward science are thought to influence future behaving such as interest in working on a science project at home and visiting a science museum.

Attitudes toward science may also express important aspects of one's personality. Katz (1968) described four functions that attitudes may serve. According to Katz, attitudes might serve an ego-defensive function. These are attitudes that protect people from unflattering truths about themselves or about others who are important to them. Attitudes may also serve a value-expressive function, which occurs when holding a certain attitude allows the person to express an important value. For example, the person who likes small, fuel-efficient cars maintains this positive attitude because their use demonstrates an important concern for energy conservation, a value of central importance to that person. A third purpose served by attitude is that of knowledge. Knowledge of attitudes allows people to better understanding other people and

events around them. Finally, attitudes may also serve a utilitarian function. These attitudes help people avoid punishment and gain rewards. When a student suddenly adopts a pro-science attitude prior to asking the teacher for more time to complete an overdue assignment, it is clear that the pro-science attitude is serving a utilitarian function.

Theories of attitude change described in the socio-psychological literature have added much to what is known about improving attitudes toward science. Based on this body of research, suggestions can now be made for enhancing the development of positive attitudes in the science classroom. Social interactions are known to influence student attitudes towards science. The fact that attitudes can be influenced by the norms and goals of groups to which students belong, want to belong, or hold in high regard provides the rationale for using social influence to improve attitudes toward science. Parents, teachers and peers are especially important to adolescents; they serve as influential agents in bringing about change in attitude toward science for better or worse (Zimbardo, 1977).

Thus, attitudes toward science may be viewed as a learned, positive or negative feeling about science that serves as a convenient summary of a wide variety of beliefs about science and is important because it influences science-related behavior. Attitudes toward science may

also serve different functions for different people. For the most part, research has focused on the attitudes object (i.e. science) without regard for the influence of significant, others known to mediate attitude change. Several social psychologists have suggested that social arrangement, situations in which people subconsciously, intuitively or deliberately perform for others, should be considered as the major determinant of attitude change (Halloran, 1967; Rokeach, 1968).

Scientific Attitudes

Gauld (1982), Noll (1933), and Burnett (1944) characterized scientific attitudes as objectivity, open-mindedness, skepticism and a willingness to suspend judgment. Gauld and Hukins (1980) stated that scientific attitudes represent the motivation, which converts this knowledge and skill into action and a willingness to use scientific procedures and methods. It may best be described as an attitude toward ideas and information and to particular ways of evaluating them. This formulation distinguishes an attitude to science or scientists on one hand from an ability to carry out scientific procedures on the other.

Scientific attitude, as the term appears in science education literature, embodies the adoption of a par-

ticular approach to solving problems, assessing ideas and information, and making decisions. Using this approach, evidence is collected and evaluated objectively so that the idiosyncratic prejudices of the one making the judgment does not intrude. No source of relevant information is rejected before it is fully evaluated, and all available evidence is carefully weighed before the decision is made. If the evidence is considered to be insufficient, then judgment is suspended until there is enough information to enable a decision to be made. No idea, conclusion, decision or solution is accepted just because a particular person makes a claim, but it is treated skeptically and critically until its soundness can be judged according to the weight of relevant evidence. A person who is willing to follow such a procedure, and who regularly does so, is said to have a scientific attitude.

Haney (1964) stated that to be scientific means that one has such attitudes as curiosity, rationality, suspended judgment, open-mindedness, critical-mindedness, objectivity, honesty and humility. Diederich (1967) listed the following as the components of persons with a scientific attitude:

. Skepticism - not taking things for granted and asking the prior question

. Faith in the possibility of solving problems

. Desire for experimental verification

. Precision

. A liking for new things

. Willingness to change opinions

. Humility

. Loyalty to truth

. An objective attitude

. Aversion to superstition

. Liking for scientific explanations

. Desire for completeness of knowledge

. Suspension of judgement

. Distinction between hypotheses and solutions

. Awareness of assumptions

. Judgement of what is fundamental and general significance

. Respect for theoretical structures

. Respect for quantification

. Acceptance of probabilities

. Acceptance of warranted generalizations

These reveal that there is no one agreed-upon list of attributes or behavior that define scientific attitudes. However, a review reveals more or less an argument concerning the nature of the items among the lists.

Scientific attitudes are those attributes which distinguish scientific thinking and problem-solving strategies from nonscientific thinking or problem solving.

Instruments used to Measure Attitudes Toward Science

In the measurement of attitude, Thurston (1947) was the first to adapt Fechner's methods of psychophysical scaling to a scaling of judgments, marked "favorable-unfavorable" or "agree-disagree," which were made to a series of statements about the subjects being assessed. Following Thurston, Likert constructed an attitude scale by which the degree or intensity of agreement, marked "strongly agree," "agree," "undecided," "disagree," "strongly disagree," could be measured for each student. Thurston-styled and Likert-styled scales have been widely used in the field of science education for measuring attitude toward science.

Some of the instruments that have been, and are being, used by researchers and that are considered to be valid and reliable are as follows:

. The Attitudes Toward Science and Science Careers (ASSC)(Allen, 1959)

. Scientific Attitude Inventory (SAI) (Moore and Sutman,1970)

. Science opinionnaire (Fisher, 1973)

. Test of Science-Related Attitudes (TOSRA) (Frasher, 1981)

. Wareing Attitudes Toward Science Protocol (WASP) (Wareing, 1982)

. Preferences and Understanding of Science (Bonnstetter, 1984)

. Science Attitude Questionnaire (Sumner, 1978)

Attitudes Toward Science and Science Achievement

Many studies have focused on the relationship between students' attitudes and science achievement including those by Alvord, 1972; Tamir, 1986; Crawley, 1985; Haun, 1958; Myers, 1967; Staver, 1986; Tunhikorn, 1986; Hamilton, 1982; Haladyna and Shaughnessy, 1982; and Al-Shargai, 1987; Simpson, 1977; Allen, 1959; Belt, 1959; Bixler, 1958; Baker, 1985; Crow and Piper, 1983; Wilson, 1983; Bloom, 1971; Jackson, 1968; Campbell and Okey, 1977; Jaus, 1975; and Novick and Duvdvani, 1976.

Alvord (1972) conducted a study on achievement and attitudes to 3,162 pupils of Grades 3,7 and 12. He found that for categories of grade level, sex, and race, significant correlations between science achievement and attitude toward school were found. Except for Black pupils in Grade 7 in most instances coefficients, ranged from 0.10 to 0.25.

Allen and Belt (1959) using large samples of about 3,000 high school seniors reported positive relationships between intelligence and favorable attitudes toward

science and scientists. Likewise, Bixler (1958) found that, in a sample of over 1000 elementary school children, intelligence was related to science attitude and science information.

In his research of about 200 college students, Myers (1967) observed no relationship between attitudes of college students toward science and their high school backgrounds in science, although attitude was correlated positively with final exam grades and final course grades in introductory college chemistry.

Novick and Duvdvani (1976) conducted a study of the relationship between school and student variables and the attitudes toward science of 684 tenth graders in Israel. Among other things, they found that achievement level is positively related to both intellectual and emotional attitudes.

Bloom (1971) and Jackson (1968) reported that students' attitudes and cognitive achievement have shown to be related, although attitudes were usually defined as attitudes toward school as an institution or toward a specific class in the school rather than toward a discipline or field of endeavor.

Kahle (1982) conducted an analysis of the 1977 National Assessment of Educational Progress (NAEP) and attitudes toward science. His analysis consists of about 200,000 respondents. The survey of attitudes toward

science suggest that minority students have positive attitudes toward science and science-related careers. However, these positive attitudes have not been accompanied by higher achievement levels in science.

Wilson (1983) conducted a meta-analysis research on science achievement and attitude. His study included Grades 3 to 12 and a population of 638,332 students. He reported that overall relationship was moderate (0.16). At elementary levels, correlations were generally quite low until Grade 6. The correlation remained consistently positive, three-quarters of the coefficients above 0.1, from Grade 7 to 11. At Grade 11, correlation dropped to 0.16, and at Grade 12, half the coefficients were below 0.12; a condition that continued into college.

Crow and Piper (1983) investigated the perceptual orientation and attitudes toward science of 47 freshmen community college students and the relationship of these characteristics toward science achievement. It was found that their attitudes toward science were related to their perceptual orientation. Students who were field independent exhibited more positive attitudes toward science. Perceptual orientation and attitudes toward science were also found to be related to achievement. Those students who were field independent and had positive attitude toward science scored significantly higher on the science achievement test than students who were field dependent

and possessed a negative attitude toward science.

Baker (1985) studied the predictive value of attitudes toward science, cognitive ability, and personality to science achievement in the middle school. His subjects consisted of 98 eighth grade middle school students of 41 males and 57 females. He reported that males and females with science grades of A and B were found to have a scientific personality, good grades in mathematics, but negative attitudes toward science. Males and females with science grades of C and D had more positive attitudes toward science, but poor mathematical grades and a nonscientific personality.

Tunhikorn (1986) conducted a study to determine the differences in attitudes toward science and achievement in physical and biological sciences of Thai boys and girls in lower secondary education. The population consisted of 709 students, 374 boys and 335 girls, in Grades 7,8, and 9 at the Kasetsart Demonstration school, Bangkok, Thailand. She found that, generally, girls had better attitudes toward science than boys as grade level increased. At all grade levels, boys performed better on achievement tests than girls in physical science, and girls performed better than boys in biological science.

Al-Shargi (1987) conducted a study to determine the differences between Saudi and non-Saudi Arab male students' attitudes toward science and science achievement in

secondary school, Riyadh, Saudi Arabia. The subjects consisted of 115 tenth grade students, 109 eleventh grade students, and 110 twelfth grade students who were enrolled in eight secondary schools. He indicated that all students involved in the study had negative attitudes toward science. Saudi students tend to have more positive attitudes than their counterparts, the non-Saudi Arabic students. The study also indicated that non-Saudi students scored higher in chemistry achievement than Saudi Arabic students.

A review of the literature on attitudes toward science and achievement reveals that some studies showed that achievement was related to attitude toward science while some studies did not. Studies that showed the relationship were done by Alford (1972), Myers (1907), Duvdvani (1976), Bloom (1971), Jackson (1968) and Piper (1973). Studies that do not show the relationship were done by Kahle (1982), Wilson (1983) and Baker (1985).

A simple tally of the studies suggests that attitudes toward science is related to achievement. However, most of the studies were found to have serious design or instrumentation flaws. As a result, it can not be stated for certain that the relationship exists.

Summary

This chapter focused on the background and educational system of the country where this research was conducted. It discussed the findings of research on test anxiety, frequent testings, and attitudes toward science. The results of this research suggest that there is no study yet that questions the effect of frequent testing on attitudes toward science. The findings of this study will shed some light into this area.

CHAPTER III

METHODOLOGY

This chapter provides a description of the methodology used in this study. It consists of the following sections: (a) Selection of sample, (b) Research Variables, (c) Criterion Instruments, (d) Research Designs and Procedures, and (e) Data Analysis.

Selection of Sample

The sample consisted of 278 students who were taking first year Chemistry at the University Technology of Malaysia. The sample included males and females. All the students in the sample were given an achievement test in Chemistry, Malaysian version of the State Trait Anxiety Inventory (Spielberger, 1977) and Science Attitude Questionnaire (Sumner, 1973) as pretests. The Science Attitude Questionnaire and State Trait Anxiety Inventory were given at the same time followed by a Chemistry achievement test on the same day. A fifteen-minute rest was provided between administration of the instruments. All the pretests were given during the first week of the semester.

The pretests were marked and students' responses

were tabulated. The mean scores on each test were calculated. The mean scores on the State Trait Anxiety Inventory and Science Attitude Questionnaire were used to assign students to high-low test anxiety and positive-negative attitude toward science for the purpose of assigning students to groups. The mean score for the test anxiety was 50.67. The mean score for the attitude toward science was 174. A score 51 and above was considered as high test anxiety while 50 and below was considered as low test anxiety. An attitude toward science score of 174 and above was considered as positive attitude toward science while 173 and below was considered as negative attitudes toward science. On this basis the samples were separated into high-low anxiety and positive-negative attitudes toward science.

Within the group of high test anxiety, positive or negative attitude toward science, pairs of high test anxiety and positive attitude toward science students were identified. students in the matched pairs were randomly assigned to group H(+) in the control group and one to group H(+) in the experimental group. Similar procedure was done for assigning groups of H(-) in the control and experimental groups. This procedure was repeated until the group of high test anxiety, positive or negative attitude were exhausted, resulting in 32 students randomly assigned to the groups H(+) in the control and experimental groups.

Also there were 29 students randomly assigned to groups H(-) in the control and experimental groups.

Within the group of low test anxiety, positive or negative attitude toward science, pairs of low test anxiety and positive attitude toward science students were identified. students in the matched pairs were randomly assigned to group L(+) in the control group and one to group L(+) in the experimental group. Similar procedure was done for assigning groups of L(-) in the control and experimental groups. This procedure was repeated until the group of low test anxiety, positive or negative attitude were exhausted, resulting in 51 students randomly assigned to the groups L(+) in the control and experimental groups. Also there were 27 students randomly assigned to groups L(-) in the control and experimental groups.

From Table 1, it can be seen that the high test anxiety-positive attitude group in the experimental and control groups had 32 students each. The high test anxiety-negative attitude in the experimental and control groups had 29 students each. The low test anxiety-positive attitude in the experimental and control groups had 51 students each. The low test anxiety-negative attitude in the experimental and control groups had 27 students each. Thus the control and experimental groupings were comprised of both high and low anxiety students. Also the experimental and control groups included students of positive and

negative attitudes toward science. Table 1 shows the distribution of the groupings.

Table 1

Table of groupings

	control				experiment			
Anxiety	High		Low		High		Low	
Attitude	(+)H	(-)H	(+)L	(-L)	(+)H	(-)H	(+)L	(-)L
Number of students	32	29	51	27	32	29	51	27

According to Cohen's (1969) sample size table, the minimum sample size required when τ =0.35, (1 - β) = 0.80 and significance level of 0.05, was 27 subjects per cell. Each cell exceeded the minimum sample size.

Research Variables

The dependent variables in the study were student achievement in Chemistry, measures of trait anxiety and attitude toward science. These variables were measured by administering selected items from the American Chemical Society Cooperative Examinations in Chemistry, State Trait Anxiety Inventory (Spielberger, 1977) and Science Attitude

Questionnaire (Sumner,1978).

The independent variable in the study was frequent testing. This was accomplished by administering achievement tests in Chemistry at two-week intervals throughout the treatment.

Criterion Instruments

The criterion instruments used in the study were as follows: (1) Selected items from the American Chemical Society Cooperative Examinations in Chemistry, (2) State-Trait Anxiety Inventory, and (3) Science Attitude Questionnaire. Each of these instruments were administered as pretests at the beginning of the semester and as a postest at the end of the semester.

Achievement in Chemistry

The test items used to measure achievement in chemistry were selected from the American Chemical Society Cooperative Examinations and translated into the Malay language. Permission was soughted to use selected items. The items were selected from the American Chemical Society Cooperative Examination in General Chemistry Form 1981B (Brief Test) and the American Chemical Society Cooperative Examination in General Chemistry, Form 1981. A

total of 130 items from the two examinations were presented to a Delphi panel consisting of eight Chemistry instructors from the Chemistry Department at the University Technology of Malaysia. Out of 130 items, 60 items were selected by the panel for inclusion in the instrument.

Scale and Scoring

All items in the American Chemical Society Cooperative Examinations in Chemistry were multi-choice and were scored using an interval scale. Each item had a one point value. The same format, scale and scoring were used for the selected items.

Content Validity

Content validity was determined by a Delphi Panel of eight Chemistry instructors from the Chemistry Department at University Technology of Malaysia. A Delphi technique was used to construct the instrument. The first draft of this instrument called for a judgement about determining whether or not each item measured one of the content objectives of the Chemistry course. Each item was judged and either accepted or rejected. Items were selected on the basis of agreement of 7 or more panel

members.

On the second round, each panel member, isolated from other members, received the selected proposed list of items and was asked to evaluate the proposed list of items as to which items clearly measured the stated objectives of the chemistry course.

Using the Delphi procedure, sixty items were identified by the panel as clearly measuring the stated objectives of the chemistry course. These items were selected to be included in the final version of the chemistry achievement test.

Reliability

Reliability of the instrument was determined by using Kurder Richardson Formula 20 (Sax, 1974).

$$KR_{20} = n/(n - 1)(SD^2 - \Sigma pq)/SD^2$$

where n = the number of items on the test.

SD^2 = the variance of scores (the standard deviation squared)

p = the difficulty level of each item or the proportion of the group that responded correctly.

q = The proportion that missed the item $(1 - p)$.

Students scores on the chemistry achievement postest were

used to determine the reliability. The reliability was found to be 0.86. A value of 0.75 was set as the stated value of acceptance. This level of acceptance was recommended by Borg (1984).

Test Anxiety

The instrument for measuring test anxiety was a translated version of the State Trait Anxiety Inventory developed by Spielberger (1977). Permission was soughted for using the test. All items in the original instrument were translated into the Malay language. Although the state and trait were given in the questionnaires only the trait questionnaires were used for the analysis. The method of scoring the items are shown on appendix D page 162.

Validation of the Translation

Following translation, the items for an experimental form were presented for evaluation by eight subject matter and language experts. Agreement among expert evaluators was interpreted as providing evidence of the content validity of the translated scale. An item was accepted when all evaluators judged the item to be satisfactorily translated. When the translators and

evaluators disagreed concerning the translation of a particular item, two or more different translations of such items were included in the preliminary form of the scale. The evaluators were then given the new version of the instrument; they re-evaluated the items until every item in the final instrument was judged to have been satisfactorily translated. Items in the final version were judged to be good or excellent by all.

Reliability

The Hoyt and Stunkard method was used for estimating the reliability of the instrument (Hoyt & Stunkard, 1952). An estimate of the internal consistency of the Likert scores assigned by respondents can be determined using the method described by Hoyt and Stunkard, which uses an analysis of variance.

This method provides a straight-forward solution to the problem of estimating the reliability coefficient for unrestricted scoring items. Let Yij represent the score obtained by the jth individual from the ith item; where i=1,2,3.....k, and j=1,2,3.....n. The various summations of the Yij gives:

Yi. the score for the ith item for all individuals; and

Y.j the sum of the scores for jth individual for all items. The matrix is shown below.

Components (items)	Subjects (respondents) 1	2	3	. .	j	. .	278	Total
1	Y11	Y12	Y13	. .	Y1j	...	Y1 278	Y1.
2	Y21	Y22	Y23	. .	Y2j	...	Y1 278	Y2.
.	.	.	.	. .	. . . . .		. . . . .	. .
.	.	.	.	. .	. . . . .		. . . . .	. .
. i	Yi1	Yi2	Yi3	. .	Yij	....	Yi 278	Yi.
.	.	.	.	. .	. . . . .		. . . . .	. .
. k	Yk1	Yk2	Yk3	. .	Ykj	.....	Yk 278	Yk.
Total	Y.1	Y.2	Y.3	. .	Y.j	.....	Y. 278	Y..

Each Yij represents the score judgementally assigned by the jth subject to the ith component. The total sum squares is given by:

$$\sum_{i=1}^{k} \sum_{j=1}^{N=278} (Yij)^2 = \left(\sum_{i=1}^{k} \sum_{j=1}^{N=278} Yij \right)^2 / 278k$$

The sum of squares for subjects is obtained by:

$$\sum_{j=1}^{N=278} (Y.j)^2/k - (Y..)^2 / 278k$$

The sum of squares for components is computed by:

$$\sum_{i=1}^{k} (Yi.)^2 /278 - (Y..)^2 / 278k$$

The residual sum of squares is subtracted out and the estimate of reliability is computed using the following formula:

r = MS subjects - MS residual/ MS subjects

The analysis of variance as suggested by Hoyt and Stunkard (1952) is shown in Table 2.

Table 2
Analysis of Variance (Hoyt and Stunkard Method) for Internal Consistency

Source of variation	d.f.	sum of squares	mean square
Among subjects	(K-1)	A	A'
Among items	n-1	B	B'
Residual	(K-1)(n-1)	C	C'
Total	Kn - 1	T	T

Reliability (r) = (A' - C')/A'

The scores from pretest and posttest test anxiety were used to determine the reliability of the instrument. The reliability of the pretest and postest were found to be 0.84 and 0.89 respectively. A value of 0.65 and above was

judged as the level of acceptance in agreement with the recommendation by Borg (1984).

Attitude Toward Science

The instrument for measuring attitude toward science was a translated version of the Science Attitude Questionnaire (Sumner,1978). Permission was soughted for using the test. All items in the original instrument were translated into the Malay language. The method of scoring the items were shown on appendix F page 177.

Validation of the Translation

Following translation, the items for an experimental form were presented for evaluation by eight subject matter and language experts. Agreement among expert evaluators was interpreted as providing evidence of the content validity of the translated scale. An item was accepted when all evaluators judged the item to be satisfactorily translated. When the translators and evaluators disagreed concerning the translation of a particular item, two or more different translations of such items were included in the preliminary form of the scale. The evaluators were then given the new version of the instrument and they re-evaluated the items until every

item in the final instrument was judged to have been satisfactorily translated. Items in the final version were judged to be good or excellent by all.

Reliability

Reliability of the instrument was determined by using the Hoyt and Stunkard (1952) method. This method provided a straight forward solution to the problem of estimating the reliability coefficient for unrestricted scoring items. The formula for calculating the reliability was previously included. The scores from pretest and postest attitude toward science were used to determine the reliability of the instrument. The reliability of the pretest and postest were found to be 0.82 and 0.85 respectively. A value of 0.65 and above was judged as the level of acceptance in agreement with the recommendation by Borg (1984).

Research Design and Procedures

One-hundred-thirty-eight subjects in the experimental group received ten multiple-choice questions once every two weeks. While 139 subjects in the control group received twenty multiple-choice questions once a month. During the whole semester, the experimental group received

a total of six tests while the control group received a total of three tests. Time required for testing and the amount of contents were adjusted evenly between subjects in the control and experimental group so as not to be biased. The tests were administered on Saturday for both groups. Students were also told the value of the test with respect to the course grading system.

Data Analysis

As previously described the purposes of the study were to investigate the following:

1. Which of the two approaches (i.e. frequent vs conventional) testing in General Chemistry for college students at University Technology of Malaysia would result in greater achievement?

2. The effect of these approaches of testings on test anxiety of the students.

3. The effect of these approaches of testings on students attitudes toward science.

A three-way analysis of covariance was used to analyze the first purpose. The covariates were the pretest scores in the chemistry achievement test.

The second and third purposes were analyzed using one-way analysis of covariance. The covariates were the

pretest scores of test anxiety and attitude toward science.

Chemistry Achievement

A three-way analysis of covariance was used to analyze student achievement. Pretest achievement scores served as the covariates. The null hypotheses for the analysis were as follows:

1. There is no significant treatment effect

$$\sigma^2 T = 0$$

2. There is no significant anxiety effect.

$$\sigma^2 A = 0$$

3. There is no significant attitude effect.

$$\sigma^2 AT = 0$$

4. There is no interaction effect.

$$\sigma^2 TxA = 0$$

$$\sigma^2 TxAT = 0$$

$$\sigma^2 ATxA = 0$$

The mathematical model used for testing these hypothesis was:

$$Yijkl = U + Ti + \tau j + \alpha k + \beta(Xijkl - \bar{X}) + \epsilon ijkl + Ti\tau j + Ti\alpha k + \tau j\alpha k$$

U = general mean

Ti = Treatment effect

τj = Anxiety effect

αk = Attitudes effect

β = regression coefficient of Y on X (the pre measure)

ϵ ijkl = error term

$Ti\tau j$ = interaction effect

$Ti\alpha k$ = interaction effect

$\tau j\alpha k$ = interaction effect

Table 3 shows the three-way analysis of covariance for analyzing the first purpose.

Table 3

Three way analysis of covariance

Source of Variation	d.f.	S.S	MS	computed F
covariates	1	A	A/1	A/MSE
treatment	1	B	B/1	B/MSE
anxiety	1	C	C/1	C/MSE
Attitude	1	D	D/1	D/MSE
Interaction				
T X A	1			
T X AT	1	E	E/3	E/3/MSE
AT X A	1			
error	270	G	G/270 =MSE	
total	277			

Note : Treatment - two level (experimental and control)

Anxiety - two level (high and low)

Attitudes - two level (positive and negative)

Analysis for Test Anxiety and Attitude Toward Science

One-way analysis of covariance was used to analyze the second and third purposes involving test anxiety and attitudes toward science of students in the control and

experimental groups. Students pretest scores on the test anxiety and attitude toward science served as covariates. The null hypothesis for the analysis was as follows: There is no significant treatment effect

$$\sigma^2 T = 0$$

The mathematical model for testing these hypothesis is:

$$Yij = U + Ti + \beta\ (Xij - \bar{X}) + \epsilon ij$$

U = general mean

Ti = first factor effect

β = regression coefficient of Y on X,

ϵij = error

Table 4 shows the one-way analysis of covariance.

Table 4

One-way Analysis of Covariance

Source of variation	d.f	SS	MS	F-ratio
covariates	1	A	A	A /MSE
treatment	1	B	B	B /MSE
error	275	E	E/276=MSE	
total	277	D		

The F-ratio was calculated according to the following formula:

$$F = MS\ treatment\ /\ MS\ error$$

Summary

Chapter III presented the methodology of the study. It discussed the sample selection, research variables, criterion instruments, research designs and procedures, and data analysis.

CHAPTER IV

THE FINDINGS

Chapter IV is organized into four sections. The first lists the research hypotheses. The second provides the data and interpretations for testing each of the research hypotheses. The final section includes a summary of the findings.

Research Hypotheses

The research hypotheses tested in this study were as follows:

1. There is no significant difference in achievement in general chemistry between the control and experimental groups.

2. There is no significant difference in achievement in general chemistry between high test anxiety student in the control and experimental groups.

3. There is no significant difference in achievement in general chemistry between low test anxiety students in the control and experimental groups.

4. There is no significant difference in achievement in general chemistry between positive attitude toward science students in the control and experimental groups.

5. There is no significant difference in achievement in general chemistry between negative attitude toward science students in the control and experimental groups.

6. There is no significant difference in achievement in general chemistry between high and low test anxiety students irrespective of the control and experimental groups.

7. There is no significant difference in achievement general chemistry between positive and negative attitude toward science students irrespective of the control and experimental groups.

8. There is no significant difference in mean test anxiety scores between the control and experimental groups.

9. There is no significant difference in mean attitude toward science scores between the control and experimental groups.

Testing the Hypothesis

Hypothesis 1

There is no significant difference in achievement in General Chemistry between the control and experimental groups.

Hypothesis 1 was tested using a three-way analysis

of covariance. The means and standard deviations of student scores in the experimental and control groups on the general chemistry achievement pretest and posttests are provided in Table 5, while the results of the three-way analysis of covariance with (pretest achievement in chemistry scores) as the covariates are presented in Table 6.

Table 5

Mean and standard deviation of the pretest and post test chemistry score in the control and experimental groups (N=278 Students).

Grouping	Mean	standard deviation
Control group		
Pretest score	11.96	4.61
Post test score	28.14	4.62
Experimental group		
Pretest score	12.00	4.60
Post test score	35.55	7.69

Table 6

Three-way analysis of covariances for chemistry achievement for treatment, anxiety and attitude toward science.

Source of variation	d.f.	sum of squares	mean square	F-ratio	sign. level
covariates					
chem.pretest	1	1369.8321	1369.8321	38.782	0.0000
Main effect	3	3852.1930	1317.3977	37.298	0.0000
Treatment	1	3787.4191	3787.4191	107.228	0.0000
Anxiety	1	159.1247	159.1247	4.505	0.0347
Attitude	1	15.8693	15.8693	0.449	0.5104
2-factor					
interaction	3	55.5949	18.5316	0.525	0.6657
Trmt x anxiety	1	1.0901	1.0901	0.031	0.8626
Trmt x att	1	15.01876	15.01876	0.425	0.5219
Anxiety x att	1	38.0684	38.0684	1.078	0.3001
Residual	270	9536.7290	35.3212		
Total	277	14914.349			

Table 5 shows that the posttest adjusted mean scores in general chemistry of students in the experimental and control groups were 35.55 and 28.14 respectively.

From Table 6, it can be seen that the students in the experimental group achieved significantly higher in general chemistry than did students in the control group. Base on these findings, Hypothesis 1 was rejected at 0.05 level of significance.

Hypothesis 2

There is no significant difference in achievement in General Chemistry between high test anxiety students in the control and experimental groups.

Hypothesis 2 was tested using a one-way analysis of covariance. Table 7 shows the mean and standard deviation of students score in general chemistry achievement test of high anxiety students in experimental and control groups. Table 8 shows the results of the one-way analysis of covariance with pretest achievement in chemistry scores serving as the covariates.

Table 7

Mean and standard deviations of chemistry scores of high test anxiety students in the control and experimental groups (N=122 students).

High anxiety	mean	standard deviation
control group		
pretest score	11.49	4.25
post test score	27.20	4.60
experimental group		
pretest score	12.13	4.07
post test score	34.67	8.18

Table 8

One-way analysis of covariance of high anxiety students in the control and experimental groups.

Source of variation	d.f.	source of squares	mean square	F-ratio	sign. level
Covariates					
pre chem.	1	1073.0236	1073.0236	29.011	0.0000
High anxiety	1	1511.0247	1511.0247	40.853	0.0000
Residual	119	4401.4272	36.9867		
Total	121	6985.4754			

Table 7 reveals that the posttest mean scores in general chemistry of high test anxiety students in the control and experimental groups were 34.67 and 27.20 respectively. From Table 8, it can be seen that the high anxiety students in the treatment group achieved significantly higher in general chemistry than did high anxiety students in the control group. Based on these findings, hypothesis 2 was rejected at 0.05 level of significance.

Hypothesis 3

There is no significant difference in achievement in General Chemistry between low test anxiety students in the control and experimental groups.

Hypothesis 3 was tested using a one-way analysis of covariance. Table 9 shows the mean, and standard deviation of students score in General Chemistry achievement test of low test anxiety students in the control and experimental groups. Table 10 shows the result of the one-way analysis of covariance with pretest achievement in chemistry scores serving as the covariates.

Table 9

Mean and standard deviations of chemistry scores of low test anxiety students in the control and experimental groups (N= 156 students).

Low test anxiety	Mean	Standard deviation
control group		
pretest score	12.33	4.87
post test score	28.88	4.52
experimental group		
pretest score	11.91	4.98
post test score	36.23	7.27

Table 10

One-way analysis of covariance of low test anxiety students in the control and experimental groups.

Source of variation	d.f.	source of squares	mean of square	F-ratio	sign. level
Covariates	1	48.59985	448.59985	13.441	0.0003
Low anxiety	1	2193.5552	2193.5552	65.725	0.0000
Residual	153	5106.3257	33.37468		
Total	155	7748.4808			

Table 9 reveals that the posttest mean scores in general chemistry of students in the control and ex-

perimental groups were 36.23 and 28.88 respectively. From Table 10, it can be seen that the low test anxiety students in the treatment group achieved significantly higher in general chemistry than the low test anxiety students in the control group. Based on these findings, Hypothesis 3 was rejected at 0.05 level of significance.

Hypothesis 4

There is no significant difference in achievement in General Chemistry between positive attitude toward science students in the control and experimental groups.

Hypothesis 4 was tested using a one-way analysis of covariance. Table 11 shows the mean and standard deviation of students scores in General Chemistry achievement test of positive attitude toward science students in the control and experimental groups. Table 12 shows the result of the one-way analysis of covariance with pretest achievement in chemistry scores serving as covariates.

Table 11

Mean and standard deviation of chemistry score of positive attitude toward science students in the control and experimental groups (N= 166 students).

Positive attitude	mean	standard deviation
Control group		
pretest score	12.52	4.65
post test score	28.01	4.57
Experimental group		
Pretest score	12.14	4.79
post test score	35.59	7.37

Table 12

One-way analysis of covariance of positive attitude students in the control and experimental groups.

Source of variation	d.f.	sum of squares	mean square	F-ratio	sign. level
Covariates	1	430.61581	430.6158	12.137	0.0006
Positive	1	2466.3815	2466.3815	69.517	0.0000
Residual	163	5783.0508	35.47884		
Total	165	8680.0482			

Table 11 shows that the posttest mean scores in general chemistry of students with positive attitude toward science in the control and experimental groups were

35.59 and 28.01 respectively. From Table 12, it can be seen that students with positive attitude toward science in the experimental group achieved significantly higher in general chemistry than students with positive attitude toward science in the control group. Based on these findings, Hypothesis 4 was rejected at 0.05 level of significance.

Hypothesis 5

There is no significant difference in achievement in General Chemistry between negative attitude toward science students in the control and experimental groups.

Hypothesis 5 was tested using a one-way analysis of covariance. Table 13 shows the mean and standard deviation of students scores in General Chemistry achievement test of negative attitude toward science students in the control and experimental groups. Table 14 shows the result of the one-way analysis of covariance with pretest achievement in chemistry scores serving as the covariates.

Table 13

Mean and standard deviation of Chemistry score of negative attitude toward science students in the control and experimental groups (112 students).

Negative attitude	mean	standard deviation
Control group		
pretest score	11.36	4.55
post test score	28.32	8.08
Experimental group		
Pretest score	11.61	4.23
post test score	35.23	4.87

Table 14

One-way analysis of covariance of negative attitude students in the control and experimental groups.

Source of variation	d.f.	sum of squares	mean square	F-ratio	sign. level
Covariates	1	1153.2175	1153.2175	32.973	0.0000
negative attitude	1	1267.9274	1267.9274	36.252	0.0000
Residual	109	3812.2748	34.9749		
Total	111	6233.4196			

Table 13 reveals that the posttest mean score in general chemistry of students with negative attitude

toward science in the control and experimental groups were 35.23 and 28.32 respectively. From Table 14, it can be seen that students with negative attitude toward science in the experimental group achieved significantly higher in general chemistry than student with negative attitude toward science in the control group. Based on these findings, Hypothesis 5 was rejected at 0.05 level of significance.

Hypothesis 6

There is no significant difference in achievement between high and low anxiety students irrespective of the control and experimental groups.

Hypothesis 6 was tested using a three-way analysis of covariance. Table 15 shows the mean and standard deviation of high and low anxiety students irrespective of the control and experimental groups. Table 6 shows the result of the three-way analysis of covariance with pretest achievement in chemistry scores serving as covariates.

Table 15

Mean and standard deviation of high and low test anxiety students irrespective of the control and experimental groups (N=278 students).

Groupings	mean	standard deviation
High anxiety		
pretest score	11.81	4.16
post test score	30.93	7.60
Low anxiety		
pretest score	12.12	4.91
post test score	32.56	6.95

Table 15 reveals that the posttest mean scores in general chemistry of the high test anxiety and low anxiety test students were 30.93 and 32.56 respectively. From table 6, it can be seen that the low test anxiety students achieved significantly higher in general chemistry than high test anxiety students. Based on this findings, Hypothesis 6 was rejected at 0.05 level of significance.

Hypothesis 7

There is no significant difference in achievement between positive and negative attitude toward science students irrespective of the control and experimental

groups.

Hypothesis 7 was tested using a three-way analysis of covariance. Table 16 shows the mean and a standard deviation of positive and negative attitude toward science students irrespective of the control and experimental groups. Table 6 shows the result of the three-way analysis of covariances with pretest achievement in chemistry serving as covariates.

Table 16

Mean and standard deviation of positive and negative attitude toward science students irrespective of the control and experimental groups (N=278 students).

Groupings	Mean	standard deviation
Positive attitude		
Pretest score	12.32	4.71
post test score	31.89	7.25
Negative attitude		
Pretest score	11.48	4.37
post test score	31.78	7.49

Table 16 shows that the posttest mean scores in general chemistry of positive attitude toward science and negative attitude toward students were 31.89 and 31.78 respectively. From Table 6, it can be seen that students

with positive attitude toward science did not achieve significantly higher in general chemistry than negative attitude toward science students. Based on this findings, Hypothesis 7 was accepted at 0.05 level of significance.

Hypothesis 8

There is no significant difference in mean test anxiety score between the control and experimental groups.

Hypothesis 8 was tested using a one-way of analysis of covariance. Table 17 shows the mean and standard deviation of test anxiety score of students in the control and experimental groups. Table 18 shows the result of the one-way analysis of covariance with pretest in test anxiety score serving as covariates.

Table 17

Mean and standard deviations of the test anxiety score of students in the control and experimental groups (N=278 students).

Groupings	mean	standard deviation
Control group		
Pretest score	51.34	5.49
post test score	51.44	6.81
Experimental group		
pretest score	51.51	5.32
post test score	45.53	5.75

Table 18

One-way analysis of covariance of test anxiety score between the control and experimental groups.

Source of variation	d.f.	sum of squares	mean square	F-ratio	sign. level
Covariates	1	10518.810	10518.810	429.178	0.0000
Treatment	1	2412.5960	2412.5960	98.436	0.0000
Residual	275	6740.0368	24.50923		
Total	277	19671.442			

Table 17 shows that the posttest mean scores of

students test anxiety in the control and experimental groups were 45.53 and 51.44 respectively. From Table 18, it can be seen that students in the experimental group did score significantly lower in test anxiety than students in the control group. Based on this findings, Hypothesis 8 was rejected at 0.05 level of significance.

Hypothesis 9

There is no significant difference in mean attitude toward science score between the control and experimental groups.

Hypothesis 9 was tested using a one-way analysis of covariance. Table 19 shows the mean and standard deviation of attitude toward science score of the control and experimental groups. Table 20 shows the result of one-way analysis of covariance of attitude toward science score between experimental and control groups with pretest in attitude toward science serving as covariates.

Table 19

Mean and standard deviation of attitude toward science score between the control and experimental groups (N=278 students).

Groupings	mean	standard deviation
Control group		
pretest score	193.22	24.87
post test score	184.60	23.07
Experimental group		
pretest score	194.31	25.98
post test score	198.19	26.98

Table 20

One-way analysis of covariances attitude toward science between the control and experimental groups.

Source of variation	d.f.	sum of squares	mean square	F-ratio	sign. level
Covariates	1	92424.266	92424.266	8.619	0.0000
Treatment	1	11430.885	11430.885	1.066	0.3028
Residual	275	2948831.3	10723.023		
Total	277	3052685.5			

Table 19 reveals that posttest mean scores of students attitude toward science in the control and

experimental groups were 198.19 and 184.60 respectively. From Table 20, it can be seen that students in the experimental group did not score significantly higher in attitude toward science than students in the control group. Based on these findings, Hypothesis 9 is accepted at 0.05 level of significance.

Reliability of Criterion Instruments

Reliability of the General Chemistry Achievement Test

The reliability of the General Chemistry achievement test was determined by using Kuder Richardson Formula 20 (Sax, 1974). Using this formula, the reliability of student scores on the posttest achievement in Chemistry test was found to be 0.86.

Reliability of the Test Anxiety Questionnaire

An estimate of the internal consistency of the Likert score of the State-Trait Anxiety Inventory assigned by the sample in this study was determined using the method described by Hoyt and Stunkard (1952). Utilizing this technique, the reliability of student scores on the pretest of State-Trait Anxiety Inventory was found to be 0.84. Reliability of the posttest for State-Trait Anxiety

lnventory was found to be 0.89.

Reliability of the Attitude Toward Science Questionnaire

An estimate of the internal consistency of the Likert score of the Science Attitude Questionnaire assigned by the sample in this study was determined using the method described by Hoyt and Stunkard (1952). Utilizing this technique, the reliability of student scores on the pretest of Science Attitude Questionnaire was found to be 0.82. Reliability of the posttest score for Science Attitude Questionnaire was found to be 0.85.

Summary of the findings

ln summary, the findings of these analysis were as follows:

1. The experimental group, who received frequent testing were found to perform significantly higher in chemistry achievement than did the control group who did not receive frequent testing.

2. The high test anxiety students in the experimental group achieved significantly higher in chemistry than the high test anxiety students in the control group.

3. The low test anxiety students in the experimen-

tal group achieved significantly higher in chemistry than the low test anxiety students in the control group.

4. Students with positive attitude toward science in the experimental group achieved significantly higher in chemistry than students with positive attitude toward science in the control group.

5. Students with negative attitude toward science in experimental group achieved significantly higher in chemistry than students with negative attitude toward science in the control group.

6. There was a significant difference in performance between the high and low test anxiety students. The low test anxiety students performed significantly higher in chemistry achievement than the high test anxiety students.

7. There was no significant difference in performance between students with positive and those with negative attitude toward science.

8. There was a significant difference in mean test anxiety score between the experimental and control groups. The experimental group had a posttest mean test anxiety score that was lower than the mean test anxiety score of students in the control group.

9. There was no significant difference in students mean attitude toward science scores between the experimental and control groups. The experimental group had a mean

attitude toward science score that was slightly higher than the mean attitude toward science score of the control group but it was not significantly different.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study compared student achievement in general chemistry at the university level under the influence of frequent testing and conventional testing. lt also examined the effects of these types of testing on students' test anxiety and attitudes toward science. This chapter summarizes the study and its findings. It also contains conclusions and discussions of the findings, as well as recommendations and suggestions for future research.

Summary

The purpose of this study was to investigate the following:

1. Which of the two approaches (i.e. frequent vs. conventional) to testing in general chemistry for college students at the University Technology of Malaysia would result in greater achievement in chemistry.

2. The effect of these approaches of testing on students' test anxiety.

3. The effect of these approaches of testing on students' attitudes toward science.

The population of the study was composed of 278 students taking first-year chemistry. The population included males and females. The students were given pretests and posttests in chemistry, test anxiety, and attitudes toward science. Scores from the pretests were used to stratify the students into experimental and control groups. The instruments used for the pretesting and posttesting were: (a) An achievement test in chemistry, (b) The State Trait Anxiety Inventory, and (c) The Science Attitude Questionnaire. The experimental group was subjected to frequent testing while the control group was subjected to conventional testing.

The items composing the chemistry achievement tests were selected from the American Chemical Society Cooperative Examination form 1981B and 1981 by a group of eight instructors in the Chemistry Department at the University Technology of Malaysia. A Delphi technique was used to select the items of the test. The selected items were translated to Malay language to be used in the research.

The State Trait Anxiety Inventory (Spielberger, 1977) was translated into Malay language and checked and validated by a group of language experts and psychologists. A similar procedure was employed for translating and validating the Science Attitude Questionnaire (Sumner, 1971).

The reliabilities of the test anxiety and attitude

toward science instruments were determined using the Hoyt and Stunkard technique. Reliability for the chemistry achievement test was determined using the Kuder Richardson formula 20.

The statistical methods used to analyze the data consisted of two techniques. A three-way analysis of covariance was used to analyze differences in chemistry achievement. A one-way analysis of covariance was used to analyze the attitudes toward science and test anxiety data.

Conclusions

Chemistry Achievement

From the findings it was concluded that frequent testing does significantly enhance achievement in chemistry, as compared with conventional testing. The study also showed that, without taking treatment into consideration, the students with lower test anxiety achieved significantly higher in chemistry than those with high test anxiety. Similarly, without taking treatment into consideration, the study showed that students with positive attitudes toward science did not perform significantly higher than students with negative attitudes toward science. The study also showed that frequent testing coupled with lower

anxiety or positive attitudes resulted in significantly higher achievement in chemistry. In other words, frequent testing resulted in significant gains in achievement in chemistry. Further, having a good attitude toward science was not enough for a significant increase achievement in chemistry.

Test Anxiety

From the findings on test anxiety it was concluded that students exposed to frequent testing were able to significantly reduce their anxiety as compared to students under conventional testing. Since students with lower anxiety achieved significantly higher in chemistry than students with high anxiety, it can be concluded that frequent testing promotes achievement indirectly by lowering anxiety.

Attitudes Toward Science

Results showed that frequent testing does increase chemistry students' attitudes toward science, but the increase was not significant. Students with positive attitudes toward science tended to perform better than students with negative attitudes toward science, although the differences were not significant. Exposing the

students to frequent testing should improve their performance. The posttest scores also revealed that students in the control group seemed to have their attitudes toward science lowered at the end of the semester.

The conclusions from the findings are limited to the University Technology of Malaysia and the similar groups that may exist.

Discussion of the Findings

Chemistry achievement

Frequent testing does significantly enhance achievement in chemistry, as compared with conventional testing. This finding reaffirmed earlier studies (Fitch, 1951; Kulp, 1934; Marso, 1970; Pikumas, 1965; Sumprer, 1982). Frequent testing may enhance achievement for the following reasons:

1. Frequent testing can help the students indirectly see the structure of the course (Standlee, 1960).

2. The instructor is able to continually analyze, restructure when necessary, and improve his or her teaching methods within a given unit of study (Stokes, 1973).

3. Smaller amounts of materials have to be studied for the frequent testing as compared with conventional

testing.

The study also showed that the students with lower test anxiety achieved significantly higher in chemistry than those with high test anxiety. The findings also reaffirmed the earlier findings by Deffenbacher (1977), Doctor and Altman (1969), Liebert and Morris (1967), Sarason (1972), and Stoops (1978). There are several possible reasons as to why high anxious persons do not perform well in examinations. Two of these follow:

1. High anxious persons, under stress, experience cognitive interference and preoccupation that make time pass slowly and results in poor performance (Stoops, 1978).

2. Worry, as a component of test anxiety, has been found to be significantly, negatively related to both performance expectancy and examination performance.

In this study, students with positive attitudes toward science did not perform significantly better than students with negative attitudes toward science. Several studies in the past showed the same result (Baker, 1985; Kahle, 1982; Wilson, 1983). Attitude toward science was not a strong factor causing higher or lower achievement in science (Al-Shargi, 1987).

Test anxiety

In this study students exposed to frequent testing were able to significantly reduce their test anxiety as compared with students under conventional testing. A possible explanation for this is that frequent testing may help to divide the course or task at hand, thus lessening the problem of study and stress.

Attitudes toward science

This study showed that frequent testing did increase chemistry students' attitudes toward science, although the increase was not significant. A possible reason for this improvement is that, as frequent testing promotes higher achievement, achievement acts to improve the attitudes (Wilson, 1983).

The study also showed that the control group students seemed to have their attitudes toward science lowered at the end of the semester. As these students were not exposed to any form of treatment, other factors could have been working to lower their attitude toward science. These factors could be the instructors, school system, curriculum, or environmental. This finding raises questions for future research.

Recommendations

Academic achievement is one of the major goals of any school system, especially at the college level in Malaysia. The results of this study support the position that frequent testing helps to achieve this goal.

In Malaysian school systems, the Ministry of Education must approve any decision made by a principal before it can be implemented. Therefore, implementing frequent testing in a school system is not an easy matter. It is suggested that additional study should be undertaken regarding the influence of frequent testing on achievement in chemistry. This should be done under the auspices or patronage of the Ministry of Education. The findings of these studies should provide further support for use of frequent testing in chemistry classes.

The study revealed that the attitude toward science of the control group seemed to be less positive at the end of the semester. Something besides the treatment caused this change in attitude. Ways to foster students' positive attitudes in chemistry should be sought. The following suggestions could be used:

1. Science curricula should reflect the affective domain in science teaching. Attention should be given to the integration of affective, cognitive, and psychomotor domains.

2. Science curricula should provide students with the experience, skills, and abilities needed for everyday life. It should prepare them to become future scientists and engineers.

3. Science curricula should reflect the needs and goals of the Malaysian society.

4. Laboratory experience should inspire independent thinking by providing students with a variety of approaches toward thinking independently, that is to apply, to synthesize, and then to evaluate.

5. The college administrators should evaluate the present semester system to determine whether it is too taxing for the students (a typical criticism). Further recommendations should be made to improve the system.

Suggested For Future Research

1. The study was conducted in one of the colleges in Malaysia, specifically the University Technology of Malaysia. The study should be repeated in other colleges in an attempt to confirm the findings.

2. The study showed that the control group attitude toward science was somewhat lowered at the end of the study. It is suggested that more research be conducted in an attempt to understand this change in attitude.

3. For the Malaysian school system, one final

examination or evaluation is the criterion always used to determine academic achievement. It is suggested that research be conducted in the schools to compare the impact of one final examination versus frequent testing on achievement in all areas of sciences.

4. Research should be conducted to find the test anxiety level of the school children at all levels and to examine the relationship between test anxiety and examination performance.

5. Further research should be conducted on the relationship between attitudes toward science and achievement in science among school children. This study did not find a significant relationship, although such relationships have been reported by others (Alford, 1972; Duvdvani, 1976; Myers, 1967; Piper, 1973).

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APPENDICES

APPENDIX A

PERMISSION LETTER

Using American Chemical Society Cooperative

Examination in Chemistry

EXAMINATIONS INSTITUTE

DIVISION OF CHEMICAL EDUCATION - AMERICAN CHEMICAL SOCIETY
University of South Florida, CHE 112, Tampa, FL 33620
(813) 974-2730

March 24, 1987

Mr. Sulaiman Yamin
Department of Mathematics, Science & Computer Education
Weineger Hall
Oregon State University
Corvallis, OR 97331

Dear Mr. Yamin:

Permission is granted to translate General Chemistry Forms 1981-B and 1981, or any parts thereof, into the Malay language for use in your research project.

We are confident that you understand the security required for these tests and are assured that you will follow the security procedures which you outlined in your letter of March 17, 1987.

Would you please send us a copy of the translated questions from our tests with the items crossed referenced to our tests and question numbers. We would like to keep a copy of the translation in our files.

Best wishes for an interesting and informative project.

Sincerely yours,

Jack C. Davis, Jr.
Acting Director

JCC/lmg

APPENDIX B

PERMISSION LETTER

Using State Trait Anxiety Inventory

CONSULTING PSYCHOLOGISTS PRESS, INC.
577 College Ave. (P.O. Box 60070), Palo Alto, California 94306 (415) 857-1444

3/17/88

Dear Sulaiman Yamin,

We appreciate your interest in our test, STAI, Form Y, by Charles Spielberger, copyright 1977, and are responding to your letter of 3/8/88, in which you request permission to translate the test into Malay for your use in research.

We would be willing to authorize you to make this translation provided you agree to the following conditions:

1. You will inform us of the subject of your research and how many copies of the translation you expect to use. If you intend to make more than 200 copies, please notify us regarding further permission and a possible fee. See below.

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Sincerely,

Pamela Griffen

Pamela J.H. Griffen
Supervisor of Contracts,
Permissions, and Licenses

Agreed to by: Sulaiman Yamin
(name)

Date: 3/30/88

Students must have a supervising professor sign this form: [illegible]
(name of professor)

Date: 5-30-88

Acknowledged by CPP: Griffen Date: 4/6/88

The fee for the reproduction of the Malay translation you had previously intended to use has been cancelled. The new fee related to your use of 278 is 78 copies x &.09 = $7.02. Thank you.

APPENDIX C

PERMISSION LETTER

Using Science Attitude Questionnaire

NATIONAL FOUNDATION FOR EDUCATIONAL RESEARCH

Clare Burstall PhD, Director

Ray Sumner PhD
EXTERNAL
RELATIONS
DEPARTMENT

Mr. Sulaiman Yamin,
37 N.W. 35th Street,
Corvallis,
OR 97330,
U.S.A.

24th March, 1988

Dear Mr. Yamin,

With reference to your letter of 1st March, I am sorry that you have not had a reply to your request to use the Science Attitude Questionnaire before now.

I have found the form that you completed last year, which Dr. Sumner had signed, approving the use of the questionnaire for your studies.

If you wish to make copies of the questionnaire you may do so, or, alternatively, we are able to send you copies free of charge.

Yours sincerely,

W. M. Crees (Mrs.)
Secretary to Dr. Ray Sumner

APPENDIX D

State Trait Anxiety Inventory

(English Version)

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-1 (STATE)

Name _____ Date _____

Age _____ Sex : M _____ F _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statements and then blacken in the appropriate circle to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately so	Very much so
1. I feel calm	1	2	3	4
2. I feel secure.....	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2 (TRAIT)

Name _____ Date ____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	Almost never	Sometimes	Often	Almost always
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected".	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me ..	1	2	3	4

38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests....	1	2	3	4

Scoring Key For STAI State and Trait

State	Points	Trait	Points
1.	4 3 2 1	21.	4 3 2 1
2.	4 3 2 1	22.	1 2 3 4
3.	1 2 3 4	23	4 3 2 1
4.	1 2 3 4	24.	1 2 3 4
5.	4 3 2 1	25.	1 2 3 4
6.	1 2 3 4	26.	4 3 2 1
7.	1 2 3 4	27.	4 3 2 1
8.	4 3 2 1	28.	1 2 3 4
9.	1 2 3 4	29.	1 2 3 4
10.	4 3 2 1	30.	4 3 2 1
11.	4 3 2 1	31	1 2 3 4
12.	1 2 3 4	32	1 2 3 4
13.	1 2 3 4	33.	4 3 2 1
14.	1 2 3 4	34.	4 3 2 1
15.	4 3 2 1	35.	1 2 3 4
16.	4 3 2 1	36.	4 3 2 1
17.	1 2 3 4	37.	1 2 3 4
18.	1 2 3 4	38.	1 2 3 4
19.	4 3 2 1	39.	4 3 2 1
20.	4 3 2 1	40.	1 2 3 4

Directions of Scoring

Example:

On item No.1:
If a student circled or blacken number one (1) then he or

she scored 4 points.
If he circled or blacken number two (2) then he scored 3 points.
If he circled or blacken number three (3) then he scored 2 points.
If he circled or blacken number four (4) then he scored 1 points.

On item No.3:
If he circled or blacken number one (1) then he scored 1 points.
If he circled or blacken number two (2) then he scored 2 points.
If he circled or blacken number three (3) then he scored 3 points.
If he circled or blacken number four (4) then he scored 4 points.

Similar procedure is to be followed for scoring the rest of the items. The score of the State anxiety is the sum of points earned from item 1 to 20. The score of the Trait is the sum of points earned from item 21 to 40. For each anxiety the higher the score, the higher is the anxiety.

APPENDIX E

State Trait Anxiety Inventory

(Malay Version)

Test Name: State Trait Anxiety Inventory

Author: Charles Spielberger

Copyright Date: 7/01/1987

Publisher: Consulting Psychologists Press, Inc.

Translator Name: Sulaiman Yamin

Date of Translation: 7/01/1987

Universiti Teknologi Malaysia
Pendidikan Sains Dan Teknik
Fakulti Sains

.....

STAI- Form Y-1

Soal Selidik Mengenai Diri Sendiri

Nama :..... Tarikh :

Arahan : Berikut adalah ayat-ayat yang sering digunakan untuk menggambarkan perasaan seseorang. Baca tiap-tiap ayat, kemudian bulatkan nombor yang sesuai yang paling tepat menggambarkan perasaan anda pada waktu itu. Tidak ada jawapan yang betul atau salah dan anda tidak perlu memikirkan jawapannya lama-lama.

		Langsung tiada	Sedikit-sedikit	Tidak berapa sangat	Terlalu
1. Saya merasa tenang	.....	1	2	3	4
2. Saya merasa selamat	.....	1	2	3	4
3. Saya merasa tegang	.....	1	2	3	4
4. Saya merasa tekanan jiwa	.....	1	2	3	4
5. Saya merasa senang	.....	1	2	3	4
6. Fikiran saya terganggu	.....	1	2	3	4
7. Sekarang saya risau memikirkan kecelakaan-kecelakaan yang mungkin menimpa	.....	1	2	3	4
8. Saya merasa rihat	.....	1	2	3	4

		Langsung tiada	Sedikit-sedikit	Tidak berapa sangat	Terlalu
9. Saya merasa takut	.....	1	2	3	4
10.Saya merasa selesa	.....	1	2	3	4
11.Saya merasa penuh keyakinan diri	.....	1	2	3	4
12.Saya merasa gelisah	.....	1	2	3	4
13.Saya merasa gementar	.....	1	2	3	4
14.Saya merasa seraba salah tidak dapat membuat keputusan	.....	1	2	3	4
15.Saya merasa tenteram	.....	1	2	3	4
16.Saya merasa puas hati	.....	1	2	3	4
17.Saya risau	.....	1	2	3	4
18.Saya merasa tegas	.....	1	2	3	4
19.Saya merasa bingung	.....	1	2	3	4
20.Saya merasa nyaman	.....	1	2	3	4

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.....

STAI - Form Y - 2

Nama : ..... Tarikh :

<u>Arahan</u> : Beberapa ayat dibawah ini sering digunakan orang untuk menggambarkan diri mereka. Baca tiap-tiap ayat dan kemudian bulatkan nombor yang sesuai yang menggambarkan perasaan anda. Tidak ada jawapan yang betul atau salah. Jangan mengambil masa yang panjang untuk tiap-tiap satu ayat tetapi beri jawapan yang paling tepat menggambarkan perasaan anda.

		Hampir tidak pernah	Kadang kala	Sering	Hampir selalu
21. Saya merasa nyaman dan tenang	.....	1	2	3	4
22. Saya merasa gemuruh dan gelisah	.....	1	2	3	4
23. Saya merasa puashati dengan diri sendiri	.....	1	2	3	4
24. Saya ingin gembira saperti orang-orang lain	.....	1	2	3	4
25. Saya merasa gagal	.....	1	2	3	4
26. Saya merasa rihat	.....	1	2	3	4

		Hampir tidak pernah	Kadang kala	Sering	Hampir selalu
27. Saya tenang, bersahaja dan sentiasa bersedia	.....	1	2	3	4
28. Saya merasa masalah semakin meningkat sehingga tidak dapat mengatasinya	.....	1	2	3	4
29. Saya selalu bimbang mengenai perkara-perkara yang sebenarnya kurang penting	.....	1	2	3	4
30. Saya gembira	.....	1	2	3	4
31. Saya selalu dilanda ingatan-ingatan yang merunsingkan	.....	1	2	3	4
32. Saya kurang keyakinan diri	.....	1	2	3	4
33. Saya merasa selamat	.....	1	2	3	4
34. Saya mudah membuat keputusan	.....	1	2	3	4
35. Saya merasa serba kekurangan	.....	1	2	3	4
36. Saya puas hati	.....	1	2	3	4
37. Ada perkara-perkara kurang penting mengharu fikiran saya	.....	1	2	3	4
38. Saya tidak dapat menerima atau melupakan sebarang kekeciwaan	.....	1	2	3	4
39. Saya seorang yang tetap pendirian	.....	1	2	3	4
40. Saya merasa tegang dan risau apabila memikirkan perkara-perkara yang saya taruh perhatian dan kecenderungan	.....	1	2	3	4

APPENDIX F

Science Attitude Questionnaire

(English Version)

SCIENCE ATTITUDE QUESTIONNAIRE

The purpose of this questionnaire is to find out what you think about SCIENCE as it is taught to you in school and how important you think it is in the world today. The questionnaire contains a large number of statements about SCIENCE. We want to know what you feel and think about these ideas and whether you agree with them or not. This is not a test and there are no right or wrong answers. We would like you to give your own opinion of each of the statements in the booklet.

DIRECTIONS

Please fill in your name and number, the name and number of your school and the other information requested below, as instructed by your teacher.

NAME OF SCHOOL.....TODAY'S DATE.....

PUPIL'S NAME.....PUPIL'S DATE OF BIRTH.....

PUPIL'S SEX [BOY OR GIRL].....SCHOOL NO.....

PUPIL'S NUMBER .....

When you have completed all the information above, try the practice question.

PRACTICE QUESTIONS.

1 Studying mathematics is fun.

<u>strongly agree</u> agree not sure disagree strongly disagree

The answer 'strongly agree' has been chosen here by underlining the word 'strongly agree'. If your answer was 'strongly disagree' you would have underlined the word 'strongly disagree'.

Now try the next practice question yourself, underlining your answer heavily in the same way.

2 mathematics should be taught only to boys and girls who want to learn it.
strongly agree agree not sure disagree

strongly disagree

Each statements in the booklet looks like the practice statements. When you read each one carefully, also read each of the choices given below it. Then decide which one answer best fits your feeling and underline the answer boldly. Please choose only one answer for each problem and try to answer every question. Rub out clearly any answer you wish to change. Do not think too long on any one statement - give the first natural answer as it come to you. Try to answer every one of the questions in the booklet.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

---

1. Science lessons are a waste of time.

strongly disagree disagree not sure agree

strongly agree

2. I enjoy other lessons more than science lessons.

much more slightly more about the same less much less

3. My science teacher is a good sort of teacher. (My science teachers are good sorts of teachers)

Definitely not no maybe yes definitely yes

4. I look forward to the time I can leave school.

very much much some a little not at all

5. There are too many facts to learn in science.

strongly disagree disagree not sure agree

strongly agree

6. Scientists make things which are a nuisance.

strongly disagree disagree not sure agree

strongly agree

7. I would like to be given a science book or a piece of scientific equipment as a present.

very much I would be please it would be all right I don't think I would like it not in the least

8. I like my science teacher(s).

not at all a little some much very much

9. People have long managed without the scientific discoveries we now have, and we too should be able to do without them.

strongly agree agree not sure disagree

strongly disagree

10. Scientific discoveries are doing more good than harm, therefore we are happier because of them.

strongly disagree disagree not sure agree

strongly agree

11. Scientists are too taken up with their work.

strongly agree agree not sure disagree

strongly disagree

12. My mother wants me to be a scientist.

not at all some not sure quit a bit very much

13. I would like to work with people who make scientific discoveries.

never seldom occasionally most of the time

all the time

14. Scientists are wasting public money.

strongly disagree disagree not sure agree

strongly agree

15. There is not enough concern about science nowadays.

strongly agree agree not sure disagree

strongly disagree

16. School is fun.

strongly disagree disagree not sure agree

strongly agree

17. I think the school should have less science periods each week.

strongly disagree disagree not sure agree

strongly agree

18. I can learn a lot by studying plants and animals in their natural surroundings.

strongly agree agree not sure disagree

strongly disagree

19. A lot more money should be spent on science.

strongly disagree disagree not sure agree

strongly agree

20. My science teacher livens up our class. (My science teachers liven up our classes).

never seldom sometimes most of the time always

21. Most of the money spent in Britain on science should be spent building more houses.

strongly disagree agree not sure disagree

strongly agree

22. Problems are being solved in science nowadays which lead to a bettering of life for mankind.

strongly agree agree not sure disagree

strongly disagree

23. I do badly in science.

very badly badly average well very well

24. Science teachers have a worse sense of humor than other teachers.

strongly agree agree not sure disagree

strongly disagree

25. We have good science teachers in this school.

strongly agree agree not sure disagree

strongly disagree

26. I should like to be anything but a scientist.

strongly agree agree not sure disagree

strongly disagree

27. Going to school is depressing.

always most of the time sometimes seldom never

28. I want to learn for myself why science experiments turn out the way they do.

very much much a little not sure not at all

29. Two hours of work in a science laboratory are more fun than a week of work in other subjects.

strongly disagree disagree not sure agree

strongly agree

30. I like my school.

very much some a little not sure I hate it

31. It is the experiments in science that make me understanding it.

strongly agree agree not sure disagree

strongly disagree

32. I enjoy school work.

none of it a bit of it some of it most of it

all of it

33. Field trips in science are a waste of time.

strongly disagree disagree not sure agree

strongly agree

34. This school is

very poorly run poorly run it's okay well run

extremely well run

35. I like to talk with people about new scientific discoveries.

not at all a little some much very much

36. I do science experiments in my spare time about:

once a week once a month once every three months

once a year never

37. I find science difficult to understand.

extremely difficult difficult in between easy

very easy

38. Scientific progress solves more problems than it creates.

strongly agree agree not sure disagree

strongly disagree

39. I would much rather do experiments in science than read about them.

never seldom sometimes most of the time always

40. I like the teachers in the school.

very much some a little not sure not at all

41. My father wants me to become a scientist.

very much much some not sure not at all

42. My science teacher is (science teachers are):

very unkind somewhat unkind fairly kind very kind

extremely kind

43. I look forward to science lessons.

always most of the time sometimes seldom never

44. We learn more by studying plants and animals in their natural surroundings than by studying them in the classroom.

strongly agree agree not sure disagree

strongly disagree

45. School is boring.

strongly agree agree not sure disagree

strongly disagree

46. It is fun to guess the outcome of science experiments.

strongly disagree disagree not sure agree
strongly agree

47. I would rather do a science experiment than listen to a lecture on the same topic.

strongly agree agree not sure disagree

strongly disagree

48. I enjoy working for my science teacher(s).

not at all some not sure much very much

49. Scientists are "show-offs".

strongly agree agree not sure disagree

strongly disagree

50. Scientific discoveries have spoilt the peace and quiet of this world.

strongly agree agree not sure disagree

strongly disagree

51. My science teacher is one (science teachers are some) of the nicest teachers on the staff.

strongly disagree disagree not sure agree

strongly agree

52. I would enjoy school more if there were no science lessons.

much more slightly more just as much less

a great deal

53. In this school, I am treated as I would like to be treated.

never seldom sometimes most of the time always

54. I would specialize in science if I had the chance.

never not likely maybe very likely definitely yes

55. The progress of science is to blame for killing millions of people.

strongly agree agree not sure disagree

strongly disagree

56. Going out to work is better than going to school.

strongly disagree disagree not sure agree

strongly agree

57. I would rather be a member of a "pop group" than a member of a science research team.

strongly agree agree not sure disagree

strongly disagree

58. I should like to belong (or I like belonging) to a science club.

very much some a little not sure not at all

Science Attitude Questionnaire Scoring Guide

Item	Direction of Scoring	Item	Direction of Scoring
1	5 - 1	2	1 - 5
3	1 - 5	4	1 - 5
5	5 - 1	6	5 - 1
7	5 - 1	8	1 - 5
9	1 - 5	10	1 - 5
11	1 - 5	12	1 - 5
13	1 - 5	14	5 - 1
15	5 - 1	16	1 - 5
17	5 - 1	18	5 - 1
19	1 - 5	20	1 - 5
21	5 - 1	22	5 - 1
23	1 - 5	24	1 - 5
25	5 - 1	26	1 - 5
27	1 - 5	28	5 - 1
29	1 - 5	30	5 - 1
31	5 - 1	32	1 - 5
33	5 - 1	34	1 - 5
35	1 - 5	36	5 - 1
37	1 - 5	38	5 - 1
39	1 - 5	40	5 - 1
41	5 - 1	42	1 - 5
43	5 - 1	44	5 - 1
45	1 - 5	46	1 - 5
47	5 - 1	48	1 - 5
49	1 - 5	50	1 - 5
51	1 - 5	52	1 - 5
53	1 - 5	54	1 - 5
55	1 - 5	56	5 - 1
57	1 - 5	58	5 - 1

An example of the scoring procedure:

Say item 1,

If a student chooses 'strongly disagree' the he scored 5 points.
If he chooses 'disagree' then he scored 4 points.
If he chooses 'not sure' then he scored 3 points.
If he chooses 'agree' then he scored 2 points.
If he chooses 'strongly agree' then he scored 1 points.

Similar scoring procedure is to used for the res of the items.
Total score is the sum of points earned from each items.
The higher the score the greater is the positive attitude toward science.

APPENDIX G

Science Attitude Questionnaire

(Malay Version)

Soalselidik Sikap Terhadap Sains
(Science Attitude Questionnaire)

Tujuan soalselidik ini adalah untuk meninjau pendapat anda mengenai pengajaran sains yang anda alami di zaman persekolahan dan sejauhh man anda fikir sains penting dalam dunia hari ini. Soalselidik ini mengandungi sejumlah besar pernyataan-pernyataan mengenai sains. Kami ingin mengetahui samada and setuju atau tidak dengan pernyataan-pernyataan tersebut. lni bukanlah satu ujian; tidak ada jawapan yang benar atau salah. Silalah nyatakan perasaan dan pendapat anda seiklas-iklasnya.

Arahan-arahan.

Sila isikan nama anda, nombor matrik dan butir-butir di bawah ini:

Nama Universiti:..... Tarikh: .....

Nama Penuntut: ..... Tarikh lahir: .....

Jantina: ..... No.Matrik: .....

Apabila anda telah selesai mengisi butir-butir di atas, cuba soalan latihan.

Soalan Latihan.

1. Belajar ilmu mathematik adalah seronok

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

Jawapan "sangat setuju" telah dipilih di sini dengan menggariskan perkataan "sangat setuju". Sekiranya jawapan anda adalah "sangat setuju" anda patut menggariskan perkataan "sangat setuju". Sekarang cuba sendiri soalan latihan seterusnya, gariskan jawapan anda dengan jelas seperti di atas.

2. llmu mathematik sepatutnya diajar hanya kepada murid lelaki dan perempuan yang mahu belajar.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

Setiap kenayataan di dalam buku kecil ini adalah seolah-

olah seperti soalan latihan.

Apabila anda baca setiap soalan, baca jua setiap pilihan di bawahnya. Kemudian pilih satu jawapan yang cocok dengan apa yang anda rasakan dan garis jawapan anda dengan terang. Sila pilih hanya satu jawapan bagi setiap soalan dan cuba jawap kesemua soalan. Padam dengan bersih mana-mana jawapan yang anda ingin tukar. Jangan fikir terlalu lama bagi sebarang kenyataan. Berikan jawapan yang spontan semasa itu juga. Cuba jawap setiap soalan di dalam buku ini.

SELAMAT MENJAWAB.

1. **Belajar sains adalah membuang masa.**

   sangat tidak setuju tidak setuju tidak pasti

   setuju sangat setuju

2. **Saya lebih seronok belajar matapelajaran lain daripada belajar sains.**

   Terlalu lebih lebih sedikit lebih kurang sama

   kurang sangat kurang

3. **Pensyarah sains saya adalah seorang yang baik.**

   Sekali-kali tidak tidak mungkin ya tentu ya

4. **Saya menanti-nanti saat tamatnya pengajian saya di universiti**

   Tersangat-sangat sangat sedikit sedikit

   sedikit sekali tidak langsung

5. **Terlalu banyak sangat fakta untuk dipelajari dalam llmu Sains**

   Sangat tidak setuju tidak setuju tidak pasti

   setuju sangat setuju

6. **Pakar sains membuat benda yang tidak berguna.**

   Sangat tidak setuju tidak setuju tidak pasti

   setuju sangat setuju

7. **Saya suka jika diberikan buku sains atau alat sains sebagai hadiah.**

   sangat suka suka biasa saja tidak suka

   tidak suka langsung

8. **Saya suka pada pensyarah sains saya.**

   tidak suka langsung suka sedikit kadang-kadang suka

   sangat suka terlalu suka

9. **Manusia sudah lama dapat hidup tanpa penemuan sains yang terdapat sekarang dan kita juga sepatutnya boleh hidup tanpa penemuan tersebut.**

   sangat setuju setuju tidak pasti

   tidak setuju sangat tidak setuju

10. **Jumpaan sains mendatangkan lebih banyak kebaikan dari keburukan dengan itu kita berasa bahagia kerananya.**

    sangat tidak setuju tidak setuju tidak pasti

    setuju sanagt setuju

11. **Para saintis terlalu mengutamakan kerja-kerja mereka.**

    sangat setuju setuju tidak pasti

    tidak setuju sangat tidak setuju

12. **Emak mahukan saya menjadi seorang ahli sains.**

    tidak mahu langsung kadang kala tidak pasti

    tidak pernah sentiasa

13. **Saya hendak bekerja dengan orang yang membuat penemuan sains.**

    tidak pernah jarang-jarang kadang-kala

    kebanyakan masa sentiasa

14. **Para saintis membazir wang orang awam.**

    sangat tidak setuju tidak setuju tidak pasti

    setuju sangat setuju

15. llmu sains tidak begitu diberi perhatian sekarang ini.

sangat setuju setuju tidak pasti

tidak setuju sangat tidak setuju

16. Pengajian di universiti adalah menyeronokkan.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

17. Saya berpendapat universiti patut mengurangkan masa pembelajaran sains setiap minggu.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

18. Saya memperolehi lebih banyak pengajaran dengan cara memerhatikan haiwan dan tumbuhan dalam keadaan semula jadi mereka.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

19. Lebih banyak wang sepatutnya dibelanjakan untuk llmu sains.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

20. Guru sains saya menghidupkan suasana kelas kami.

tidak pernah jarang-jarang kadang-kala

kebanyakan masa selalu

21. Kebanyakan wang dibelanjakan untuk kemajuan sains di Malaysia sepatutnya dibelanjakan untuk mendirikan perumahan.

Sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

22. Banyak masalah sedang diselesaikan oleh sains sekarang yang membawa kepada kehidupan ynag lebih baik untuk manusia.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

23. Saya lemah dalam matapelajaran sains.

sangat lemah lemah sederhana baik sangat baik

24. Pensyarah sains mempunyai gaya jenaka yang rendah dari pensyarah lain.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

25. Kami mempunyai pensyarah sains yang baik di universiti ini.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

26. Saya suka menjadi apa saja kecuali ahli sains.

Sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

27. Masuk universiti mengecewakan.

sentiasa kebanyakan masa kadang-kala

jarang-jarang tidak pernah

28. Saya mahu mengetahui dengan sendiri mengapa ujikaji sains berjaya sebagaimana sepatutnya.

terlalu ingin sangat ingin sedikit keinginan

tidak pasti tidak mahu langsung

29. Dua jam membuat kerja dimakmal sains adalah lebih menyeronokkan dari bekerja seminggu untuk matapelajaran.

Sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

30. Saya suka universiti ini.

sangat suka suka sedikit sangat sedikit suka

tidak pasti saya benci

31. Ujikaji-ujikaji sainslah yang menyebabkan saya mudah faham.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

32. Saya suka membuat tugasan-tugasan di universiti.

tidak satu pun sedikit saja sebahagian saja

kebanyakannya kesemuanya

33. Kerja luar sains membuang masa saja.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

34. Pentadbiran universiti ini dijalankan dengan

sangat lemah lemah sederhana baik sangat baik

35. Saya suka bercakap dengan sesiapa berkenaan dengan penemuan-penemuan sains yang baru.

tidak suka langsung suka sedikit suka

sangat suka tersangat suka

36. Saya gemar melakukan ujikaji sains dalam masa lapang saya, lebih kurang:

seminggu sekali sebulan sekali tiga bulan sekali

setahun sekali tidak pernah langsung

37. Saya mendapati llmu sains sukar difahami.

sangat sukar sukar sederhana mudah sangat mudah

38. Kemajuan sains lebih banyak menyelesaikan masalah dari menciptanya.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

39. Saya lebih suka membuat ujikaji dalam llmu sains daripada membaca mengenainya.

tidak pernah jarang-jarang kadang-kala

kebanyakan masa sentiasa

40. Saya suka pensyarah-pensyarah di universiti ini.

sangat suka suka sedikit terlalu sedikit suka

tidak pasti tidak suka langsung

41. Ayah mahukan saya menjadi seorang ahli sains.

terlalu sangat sangat sedikit tidak pasti

tidak langsung

42. Pensyarah sains saya adalah seorang yang

sangat tidak baik hati kurang baik hati

sederhana baik sangat baik hati terlalu baik hati

43. Saya sentiasa tertunggu-tunggu untuk mengikuti mata pelajaran sains.

sentiasa kebanyakan masa kadang-kala

jarang-jarang tidak pernah

44. Kita memperolehi lebih banyak pengajian dengan memerhatikan tumbuhan dan haiwan dalam keadaan sekeliling semulajadi mereka dari mempelajari dalam bilik darjah.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

45. Menuntut di universiti adalah membosankan.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

46. Meneka hasil ujikaji sanins adalah menyeronokkan.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

47. Saya lebih suka membuat ujikaji sains daripadda mendengar syarahan mengenai topook yang sama.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

48. Saya seronok bekerja dengan pensyarah sains saya.

tidak perlu langsung sedikit perlu tidak pasti

perlu sangat perlu

49. Ahli sains merupakan orang yang suka menunjuk-nunjuk.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

50. Penemuan sains adalah meosakkan keamanan dan ketenteraman di dunia ini.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

51. Pensyarah sains saya merupakan seorang yang terbaik di antara pensyarah-pensyarah lain.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

52. Saya lebih menggemari pengajian di universiti jika tidak terdapat pelajaran sains.

sangat lebih lebih sedikit serupa saja

kurang sangat kurang

53. Di universiti ini, saya dilayan sebagaimana yang saya mahu.

Tidak pernah jarang-jarang kadang-kala

kebanyakan masa sentiasa

54. Jika diberi peluang saya suka membuat pengkhususan dalam llmu sains.

Tidak suka langsung tidak mungkin suka mungkin

besar kemungkinan sudah pasti

55. Kemajuan sains patut disalahkan kerana membunuh berjuta manusia.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

56. Bekerja lebih baik dari menuntut di universiti.

sangat tidak setuju tidak setuju tidak pasti

setuju sangat setuju

57. Saya lebih suka menjadi ahli "kumpulan pop" dari menjadi kumpulan sains.

sangat setuju setuju tidak pasti tidak setuju

sangat tidak setuju

58. Saya suka menjadi ahli kelab sains.

sangat suka suka sedikit sangat sedikit suka

tidak pasti tidak suka langgsung