

1993

## Differences in attitude towards mathematics between successful regular class children and children with learning problems in mathematics

Jennifer Poller  
*Edith Cowan University*

Follow this and additional works at: [https://ro.ecu.edu.au/theses\\_hons](https://ro.ecu.edu.au/theses_hons)



Part of the [Science and Mathematics Education Commons](#)

---

### Recommended Citation

Poller, J. (1993). *Differences in attitude towards mathematics between successful regular class children and children with learning problems in mathematics*. Edith Cowan University. [https://ro.ecu.edu.au/theses\\_hons/599](https://ro.ecu.edu.au/theses_hons/599)

This Thesis is posted at Research Online.  
[https://ro.ecu.edu.au/theses\\_hons/599](https://ro.ecu.edu.au/theses_hons/599)

# Edith Cowan University

## Copyright Warning

You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorize you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.
- A reproduction of material that is protected by copyright may be a copyright infringement. Where the reproduction of such material is done without attribution of authorship, with false attribution of authorship or the authorship is treated in a derogatory manner, this may be a breach of the author's moral rights contained in Part IX of the Copyright Act 1968 (Cth).
- Courts have the power to impose a wide range of civil and criminal sanctions for infringement of copyright, infringement of moral rights and other offences under the Copyright Act 1968 (Cth). Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

**DIFFERENCES IN ATTITUDE TOWARDS MATHEMATICS BETWEEN  
SUCCESSFUL REGULAR CLASS CHILDREN AND CHILDREN WITH  
LEARNING PROBLEMS IN MATHEMATICS.**

**BY**

**Jennifer Poller B. A. Education.**

**A Thesis Submitted in Partial Fulfilment of the  
Requirements for the Award of**

**Bachelor of Education with Honours  
at the School of Education, Edith Cowan University**

**Date of Submission: 3.12.93.**

## USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

## Abstract

Possible differences in attitude towards mathematics were studied between Year seven successful regular class children and Year seven children with learning problems in mathematics. A comparison was also made between the Year seven children with learning problems and a younger chronological age group (Year 5) who were performing at approximately the same level in mathematics. A sample of 180 students (30 Year 5 males, 30 Year 5 females, 30 Year 7 regular class males, 30 Year 7 regular class females, 30 Year 7 learning problems males and 30 Year 7 learning problems females) was selected from students in seven local Primary Schools. Student mathematical achievement was determined by the Progressive Achievement Tests in Mathematics (Level 2a).

Mean differences across the six groups of students were calculated on three attitude subscales. These scales measured school-related affect (attitude to school); subject-related affect (attitude to mathematics) and academic self-concept (attitude towards self about mathematical ability). Stepdown E tests were used to determine the relative importance of each affect variable. The research study sought to determine if academic self-concept was the primary affect variable differentiating the groups. It was hypothesised that differences in subject-related affect and school-related affect would not be significant after academic self-concept was partialled from the relationship.

Findings indicate that significant differences exist between groups in terms of academic self-concept, subject-related affect and school-related affect when these variables were assessed univariately. The significant finding was that when attempting to examine differences between groups in mathematics, all three affect variables should be considered. This is due to the the school-related affect variable being found to add significantly to the differences between groups even when student academic self-concept was partialled from the analysis. No significant difference was found between students in terms of gender on any affect measure.

### Declaration

"I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text."

Signature..

Date.....20/5/94.....

## **Acknowledgements**

I would like to express my sincere thanks to my supervisor Professor Peter Cole for the assistance and encouragement he has given me in the preparation of this thesis. Thank you also to my family for the support they have given me in so many ways throughout the year.

## Table of Contents

	Page
Abstract	ii
Declaration	iv
Acknowledgements	v
List of Tables	ix
List of Figures	x
Chapter	
I. INTRODUCTION	1
Student entry characteristics	3
Affective entry characteristics	4
School-related affect	6
Subject-related affect	7
Academic self-concept	10
Affect and academic achievement	13
Affect and motivation	13
Purpose of the study	15
II. REVIEW OF THE LITERATURE	17
Introduction	17
Cognitive and affective factors in the learning of mathematics	17

	<b>Page</b>
Relationships between student attitudes and mathematics achievement	19
Development of attitudes towards mathematics	21
Success/failure experiences and their effects on student academic self-concept	27
Gender differences in student attitudes	34
Summary	37
<b>III. METHODOLOGY</b>	<b>40</b>
Design of the study	40
Subjects	41
Instruments	42
Research design	48
Data collection procedures	50
Data analysis procedures	53
Research hypotheses	53
<b>IV. DATA ANALYSIS</b>	<b>57</b>
Results	59
Interaction (Achievement Level x Gender)	63
Planned comparison: Year 7 Successful Normal vs Year 7 learning problems group	65
Planned comparison: Year 5 Normal vs Year 7 learning problems group	67
Gender	69

Summary	69
V. DISCUSSION	72
Significance of the results to education	80
Limitations of the study	83
VI. REFERENCES	85
VII. APPENDICES	89
(A) Attitude scales	
(i) Student practice sheet	89
(ii) General school-related affect questionnaire	90
(iii) Mathematics-related affect questionnaire	91
(iv) Mathematics self-concept questionnaire	92
(B) Student questionnaire instruction sheet	93

## **List of Tables**

	<b>Page</b>
<b>Table 1.</b> Subject data	<b>43</b>
<b>Table 2.</b> Means and standard deviations by level and gender for three affect measures	<b>60</b>
<b>Table 3.</b> Correlation matrix depicting relationships among the dependent variables for each cell in the design	<b>62</b>
<b>Table 4.</b> Analysis of variance comparing Yr 7SN and Yr 7LP	<b>66</b>
<b>Table 5.</b> Analysis of variance comparing Yr 5N and Yr 7LP	<b>68</b>

## List of Figures

	Page
Figure 1. General entry characteristics and learning outcomes.	8
Figure 2. Mathematics entry characteristics and learning outcomes	12
Figure 3. Subject response to stimulus question and related question.	48
Figure 4. Mean differences among groups on three dependent variables	61
Figure 5. Mean academic self-concept scores by level and gender	64
Figure 6. Mean school-related affect scores by level and gender.	65

## CHAPTER I

### Introduction

There is a strong emphasis placed upon mathematics and mathematical learning within Australian schools. The National Statement on Mathematics for Australian Schools outlines the impact mathematics has upon students in this country (Australian Education Council, 1990, p.5). This statement indicates that the most commonly used forms of mathematics include number and quantification and are used in activities such as shopping, reading road maps, carrying out simple calculations and understanding weather predictions. These activities play an important part in the lives of most members of Australian society. The areas mentioned above constitute personal uses of mathematics; everyday occurrences of mathematics in the personal lives of Australians.

There are other uses of mathematics in Australian society, and these constitute civic and vocational applications of mathematics. Civic uses of mathematics allow people to participate successfully in society through the ability to understand research presented by the media and interpret information in order to make informed decisions about issues affecting their lives. Vocational areas of mathematics usage range from the tabulation of the daily takings of a small business to the construction of building designs in architecture (Australian Education Council, 1990, p. 6).

Due to the ubiquitous nature of mathematics in Australian society it is important that "more students leave school enthused by, and justifiably confident with mathematics" (Australian Education Council, 1990, p. 7). The importance of this lies in the finding that Australia's demand for appropriately mathematically skilled people is increasing whilst supply is decreasing (Australian Education Council). The more mathematically capable students become, the more likely they are to develop into fully contributing members of society.

The Australian Education Council (1990) states that "Whatever their particular needs or abilities, all students have the right to learn mathematics in a way that is personally challenging and stretches their capabilities" (p.10). It is therefore very important that teachers assist all student towards this end, including students with learning problems in mathematics. Even though they may have difficulty in mathematics, these students have the potential to become contributing members of society and must be given every opportunity to succeed.

In order to assist children to become more mathematically literate, teachers need to be aware of factors that may influence the mathematical achievements of their students. Some obvious factors that may contribute to student difficulty in mathematics are found in students who have an "intellectual, physical or sensory handicap which interferes in

some way with their capacity to engage in all the experiences of typical classrooms" (Australian Education Council, 1990, p. 10). The potential for achievement by these students is restricted by their limited ability to interact successfully with the learning environment. Other children may be influenced by lack of motivation, lack of interest or lack of self-esteem, all variables which have the potential to limit success in mathematics. Even though students exhibiting these behaviours have no inherent handicap, their mathematical achievement may be severely limited.

From this it can be seen that a lack of achievement in mathematics may not necessarily be a result of a lack of achievement potential. Physical, social and affective factors have the ability to influence student academic achievement in mathematics. Three affective factors will be outlined in the following section. These include school-related affect, subject-related affect and academic self-concept.

#### Student Entry Characteristics

Bloom (1976) has identified important entry characteristics that predict differences in academic achievement among students within school settings (p. 73). Entry characteristics are "student characteristics that are believed to be central in determining student learning" (Bloom, 1976, p. 11). Bloom identifies two types of entry characteristics that students will bring to the learning situation,

cognitive entry characteristics and affective entry characteristics.

Cognitive entry characteristics are identified as "the extent to which the student has already learned the basic prerequisites to the learning to be accomplished" (Bloom, 1976, p. 10) and affective entry characteristics are "the extent to which the student is (or can be ) motivated to engage in the learning process" (Bloom, 1976, p. 11). The entry characteristics that will be discussed in this chapter are the affective entry characteristics associated with mathematical tasks.

Before discussing the dimensions of entry characteristics that pertain to mathematics learning, it is necessary to define a key term that will be used throughout this discussion. This term is student attitude. When used in the following context, attitude will be taken to mean a "learned predisposition or tendency on the part of an individual to respond positively or negatively to some object, situation, concept, or another person" (Aiken, 1970, p. 551).

#### Affective Entry Characteristics

Affective entry characteristics are feeling and attitude states that result from the interaction between students' previous experience with the learning task and their expectations for success in the future. Students approaching a task for the first time bring with them a set of affective entry

characteristics that have been developed as the result of previous interaction among students, parents, teachers and peers. During the learning task, these initial affective entry characteristics are either reinforced or challenged depending upon how the students' initial expectations match the actual experience. If for example, the task matches the students' expectations, initial affective entry characteristics will be reinforced and attitudes and views relating to the task strengthened. If the experience is different to the students' expectations, the initial characteristics will be challenged and new affective entry characteristics developed. The result is that students leave the learning situation with a set of affective characteristics that relate specifically to the task completed. The next time a similar situation is encountered, these altered characteristics become the affective entry characteristics. For each successive interaction, the history of previous interaction with that task or similar tasks will influence the affective characteristics displayed by the learner.

Affective entry characteristics can be described in the context of three areas of school learning. These areas include affect relating to school (school-related affect); the subject area being studied (subject-related affect); and the students' perceptions of their ability in that subject area (academic self-concept). Each of these will be discussed in relation to their effects on the learning of mathematics.

### School-related Affect.

The variable school-related affect refers to "a general attitude toward (or interest in) schools and schooling" (Bloom, 1976, p.85). In this context, the student would be asked a question similar to "How do you feel about school?". The response gives some indication as to the students' attitudes towards school as a whole.

Affect towards school develops as a result of interaction among learners, teachers, parents, peers and success and failure experiences. Students who consistently succeed in the many aspects of school life are likely to receive the approval of teachers, parents and peers. A consistent mixture of success and approval can assist in the development of positive affective characteristics towards school. Positive affect may then lead to a continuous cycle of success and approval resulting in the development of stronger positive affect towards school.

The reverse of this situation may also be true. Consistent failure and disapproval from teachers, parents and peers can assist in the development of negative affective characteristics which may perpetuate the cycle of failure and disapproval.

Success and failure experiences and the reactions of others to those successes and failures have both positive and negative influences on the development of attitudes towards school. The reaction or lack of reaction these people exhibit

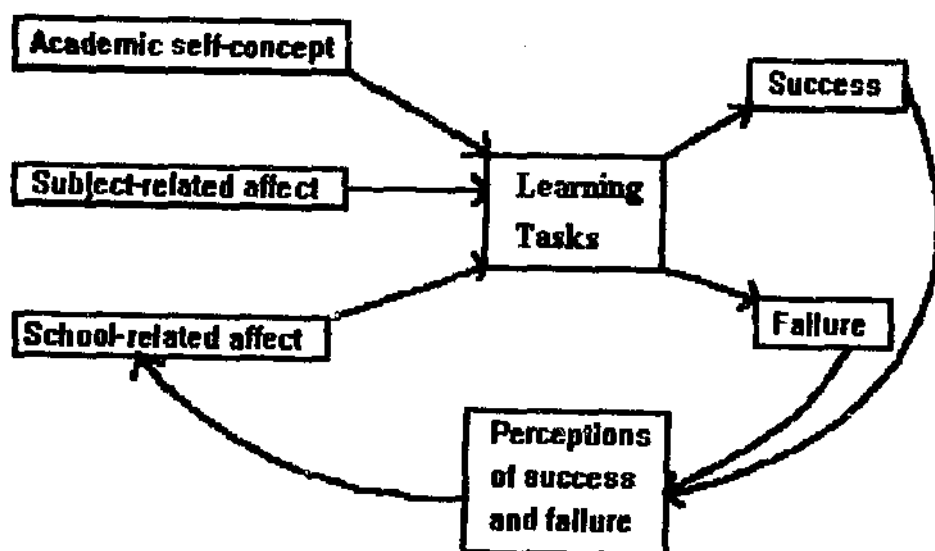
towards students' successes or failures help the students to develop an understanding of the importance of their achievement or lack of achievement. If as a result of the interaction with others the students perceive their successes or failures to be unimportant, a different affect towards schooling will develop than if their successes or failures were perceived to be important. Bloom, (1976) summarised research and provided data on the importance of mathematics affect and subsequent mathematical learning. The assumption is that it is not entirely the students' actual successes or failures in school that result in the formation of school-related affect, but their perceptions of those successes and failures that develop as a result of interaction with others (see Figure 1).

#### Subject-related Affect.

Subject-related affect refers to "a continuum ranging from positive views, likes, or positive affect toward a subject to negative views, dislikes, or negative affect toward the subject" (Bloom, 1976, p.77). As such they are the specific feeling and attitude states that relate to the learning of a particular subject area. In this case, subject-related affect will be in relation to the learning of mathematics. Mathematics-related affect is therefore the specific feeling and attitude states that students have developed towards mathematics or mathematical problem solving. Mathematics-related affect refers specifically to whether or not students have positive attitudes towards

**Affective entry characteristics**

**Learning outcomes**



**Figure 1.** General affective entry characteristics and learning outcomes. Figure 1 depicts the three input variables that relate to a learning task. The two learning outcomes of the task are identified and a feedback variable is shown which indicates the relationship between these learning outcomes and the affective entry characteristics.

mathematics. The degree of affect that students form about mathematics develops as a result of the history of interaction between the student and the subject. Bloom (1976), proposes that a student "tends to like those activities which he believes he has done or can do successfully" (p. 78). If students believe they are successful in mathematics, positive affects towards the subject are likely to develop. It is important to note that it is a student's belief that he/she can do mathematics activities successfully that results in positive affect towards the subject. Similarly, the belief that they cannot complete mathematics activities successfully is likely to result in negative affect towards the subject.

Beliefs about success develop as a result of the interaction among student perception, task importance and task difficulty. Success or failure in a task perceived to be important by the child will result in the development of stronger affect towards the task than the same degree of success or failure in a task perceived to be unimportant. Students who succeed at an important task are likely to develop positive affect toward that task, whereas students who fail at an important task are likely to develop negative affect toward that task. Success or failure in an unimportant task will have little impact upon affect development.

Task difficulty also influences the development of affect in that achievement on a task perceived to be difficult by the

learner will have more impact upon the development of affect than achievement on a task perceived to be easy (Bloom, 1976, p.78). More importance will be attributed to success in a difficult task than success in an easy task and less importance will be attributed to failure in an easy task than failure in a difficult task. This interaction between perceived task importance and difficulty may account for differences in attitudes between children who have the same average level of success in mathematics. Students' beliefs about task importance and task difficulty develop through interactions with significant others in the same way that beliefs about school were developed.

#### Academic self-concept.

The variable academic self-concept is defined as the student's "attitudes towards the self about school learning" (Bloom, 1976, p. 92). It can be used in relation to specific school subjects such as mathematics. Mathematics self-concept is therefore student attitude towards the self about personal capabilities in mathematics and mathematical learning (see Figure 2). Bloom (1976), indicates that in the early school years the learner attributes success or failure to external factors such as the school, the teacher or the task, but by the years four to six, the learner begins to shift the focus of these attributions towards the self. This shift from external to

internal forces signifies the beginning of the formation of mathematics self-concept.

Bloom (1976) has stated that

The student who consistently succeeds in school must generalize to approval of the self and a generally positive concept of the self as a learner. The student who has consistently failed (and is reminded of this by his teachers and parents) must come to view himself with a generally negative self-concept as a learner. (p. 93)

Student perception of the importance of success and failure also plays a part in the formation of the mathematics self-concept. Since success or failure is attributed to the learner rather than factors beyond the learner's control, continued success in mathematics will develop into a positive mathematics self-concept whereas continued failure will develop into a negative mathematics self-concept. These successes or failures do however need to be consistent. An isolated incidence of success is likely to have little impact upon increasing the mathematics self-concept of a student if that student possesses a negative self-concept about their ability in mathematics. Similarly, an isolated incidence of failure is likely to have little impact upon decreasing a student's positive self-concept towards mathematics.

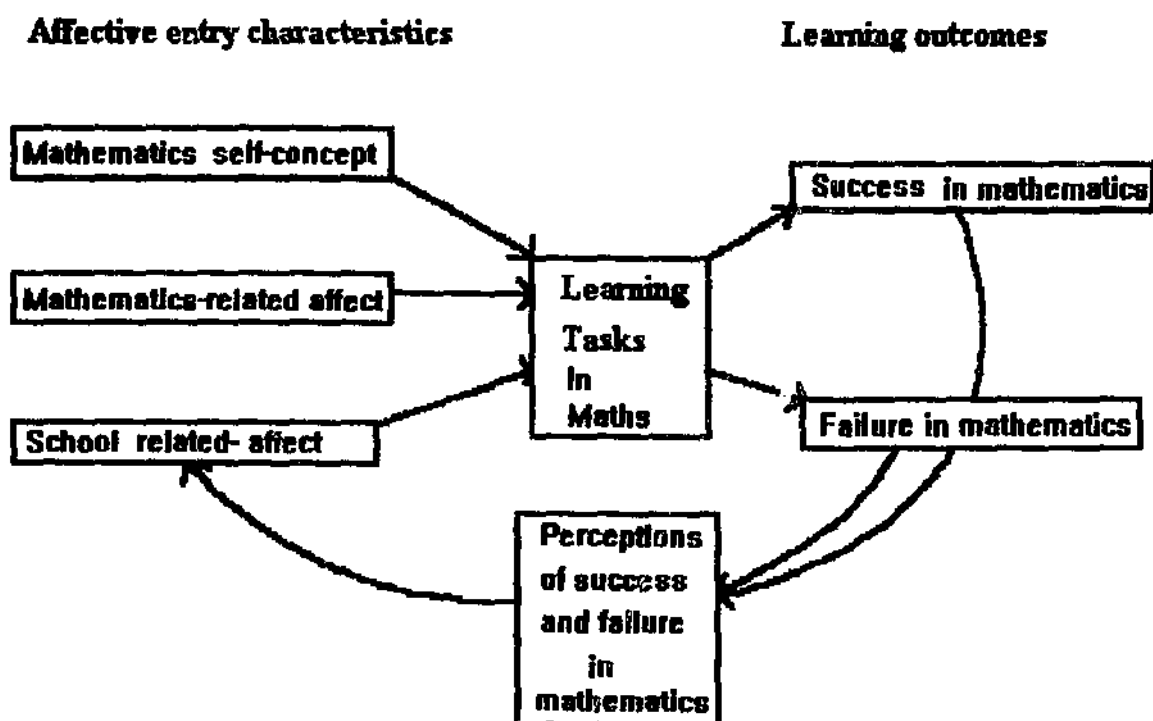


Figure 2. Mathematics entry characteristics and mathematical learning outcomes. Figure 2 depicts the three input variables that relate specifically to the mathematics learning task. Two learning outcomes of mathematics are identified and a feedback variable is shown which relates these learning outcomes back to the specific mathematics entry characteristics.

### Affect And Academic Achievement

The capacity of affective characteristics to predict academic achievement in mathematics can be demonstrated in many settings. The set of median correlations by Bloom (1976), indicates that after grade five, school-related affect is correlated with academic achievement at +.25 (p.92) , subject-related affect is correlated with academic achievement at +.31 (p. 85); and academic self-concept is correlated with academic achievement at +.50 (p. 94). These results indicate that of the three affective entry characteristics, academic self-concept has the strongest correlation to academic achievement and therefore the strongest predictive ability. Bloom (1976), states that "for most practical purposes, academic self-concept is likely to be the one best index of affective entry characteristics - at least for predictive purposes" (p. 97).

Kim and Hunter (1993) support this argument in that they indicate that the most accurate variable in predicting academic achievement in mathematics will be that which demonstrates attitudinal relevance. "Attitudinal relevance is defined as the degree of match between attitudinal and behavioural elements" (Kim & Hunter, 1993, p.115).

### Affect And Motivation

An understanding of affective entry characteristics is important because of the impact they may have upon student motivation to succeed. Students with histories of success with

a task are likely to develop high expectations about their ability to succeed at that task, whereas students with histories of failure are likely to develop low expectations about their ability to succeed. Expectations of success or failure influence student motivation in that expectations of success (positive affect) are related to an adaptive motivational pattern and expectations of failure (negative affect) are related to a maladaptive motivational pattern (Dweck, 1986, p.1040). Students with adaptive motivational patterns demonstrate "challenge seeking and high, effective persistence in the face of obstacles", while children with maladaptive motivational patterns demonstrate "challenge avoidance and low persistence in the face of difficulty" (Dweck, 1986, p.1040). Students with adaptive motivational patterns are more likely to persist with a difficult task and exert the effort necessary to successfully complete that task than students with maladaptive motivational patterns.

These motivational patterns are of particular importance to children with learning problems in mathematics due to the fact that these children have histories of failure throughout their experiences with mathematics. A history of failure, coupled with expectations for failure in the future, will lead to the development of maladaptive motivational patterns by these children. When faced with a difficult situation they are more likely to respond with low persistence, thus allowing

them less opportunity for success. The lack of success these students experience, combined with the maladaptive motivational pattern that develops, may contribute to future failure in mathematics. A cycle of failure and negative affect and continued failure is then likely to become evident.

#### Purpose Of The Study

The purpose of this study was to investigate if differences exist between successful regular class children and children with learning problems in mathematics in terms of their attitudes towards mathematics and related affect variables. Of the two models detailed earlier, the second, mathematics-based model was the basis for this research. It can be seen that in model two, two of the affective entry characteristics were altered to relate specifically to mathematics and the school-related affect variable remained the same for both models.

The primary objective of the study was to explore differences on these affect variables between children with learning problems in mathematics and children without learning problems in mathematics. In essence, relationships among the dependent variables (mathematics self-concept, mathematics-related affect and school-related affect) were examined to determine which of these variables differentiated the students with learning problems from successful children in regular classes.

Success or failure in mathematics related to the level of achievement of the students in the sample groups, thus differentiating them as successful normally achieving students and children with learning problems in mathematics (failure experiences). The successful and unsuccessful groups were compared on the three affective variables and differences were analysed in terms of the composite results for both males and females. Results were then determined individually in terms of gender.

The key purpose of the study was to determine if the mathematics self-concept variable was in fact the critical variable in differentiating groups. The mathematics self-concept variable correlates with the other affect variables but the question was whether or not these subsequent variables were important. Mathematics-related affect and school-related affect would prove to be unimportant if measures of the mathematics self-concept variable, when taken alone, accounted for the majority of the differences in affect between groups.

## CHAPTER II

### Review Of The Literature

The following chapter will discuss research findings related to the model depicted in the previous chapter. The relationship between cognitive and affective student characteristics in determining student mathematics achievement will be outlined. The focus of the chapter will be the affective student characteristics and their relationship with mathematics learning. The influence of success and failure experiences on these affective characteristics will be determined, as well as the ways in which affect variables may in turn influence achievement. The different affective characteristics will then be discussed relative to gender differences.

### Cognitive And Affective Factors In The Learning Of Mathematics

Mathematics learning is essentially a cognitive process that requires the understanding of concepts and the acquisition of skills. Before any new learning can occur however, students must have mastered the necessary pre-skills associated with the learning task (Silbert, Carnine & Stein, 1990, p .5). The history of previous development and learning that occurs before the student comes in contact with the new learning task is defined by Bloom (1976) as the cognitive entry behaviours. Cognitive entry behaviours are important in mathematical

learning in that they influence students' abilities to succeed with the next learning task. Students who have a repertoire of previous learning and development associated with the task will be more likely to succeed than students without these prerequisite skills. The student with previous learnings will have a basis upon which to build the new information. In this way, the cognitive entry behaviours students have before encountering a mathematical task are capable of influencing their subsequent achievement in mathematics.

Leder (1992) stresses that in order to understand mathematics learning, it is important to examine not only the cognitive aspects of the task but also the affective factors that are related to achievement in this area. Affective factors are important because "students' attitudes towards mathematics are likely to influence their learning of mathematics" (Leder, 1992, p. 5). Leder (1992), indicates that it is possible to identify students' attitudes towards mathematics by observing their reactions to situations in which mathematics occurs.

The Australian Education Council (1990) has argued that positive attitudes enhance achievement in mathematics. This is reflected in the Council's statement that

An important aim of mathematics education is to develop in students positive attitudes towards mathematics. . . .

The notion of having a positive attitude towards mathematics encompasses both liking mathematics and

feeling good about one's own capacity to deal with situations in which mathematics is involved. (p. 31)

The two attitudes identified by the Australian Education Council have been defined in this paper as mathematics-related affect and mathematics self-concept. They are the affective entry characteristics that relate specifically to mathematical learning. Of the two affect variables, the Council considers the need to increase students' positive attitudes about the self towards mathematical learning to be the greatest consideration. Teachers are also urged to address the problem that students' attitudes towards mathematics become increasingly negative throughout their experiences within the school setting. The Council indicates that the development of positive attitudes towards mathematics should be addressed explicitly in the teacher's approach to the mathematics education of the students.

#### Relationships Between Student Attitudes And Mathematics Achievement

Dungan and Thurlow (1989) reviewed research findings that indicated that favourable attitudes to mathematics do not necessarily lead to high achievement and that high achievement in mathematics does not necessarily lead to favourable attitudes towards the subject. They have stressed that a reciprocal relationship exists between these two key variables. This means that "higher achievement in

mathematics may result in more positive attitudes towards the subject which, in turn, may encourage higher mathematical achievement" (Dungan & Thurlow, 1989, p. 9). Equally, lower achievement in mathematics may result in more negative attitudes towards the subject which may lead to lower achievement. It appears that the two variables, achievement and attitude, develop concurrently throughout the student's experiences with mathematics. Research has not determined that one variable causes the other but that a relationship has been shown to exist between the two.

Schofield (1982) set out to determine the nature of the relationship between student attitudes and achievement in mathematics. Children in grades three through six were administered mathematics achievement tests and attitude scales twice during a one year period. Results of the study indicated differences in the relationship between attitude towards mathematics and achievement in the subject. This relationship was found to be the strongest for the males in the study whose results showed significant positive correlations between attitude and achievement. Results for girls found only a low positive correlation between these two variables. Schofield found that liking of mathematics by girls would not serve as an adequate indication of their success in the subject.

A stronger correlation between attitude and academic achievement was found at the end of the year than at the

beginning of the year. Schofield (1982) suggests that this is the result of the "reciprocal association between success and liking (and, conversely, failure and disliking)" (p. 284). The longer the students experienced mathematics in the class, the more their attitudes towards the subject appeared to be related to their achievement levels.

Swafford and Brown (1989), for the National Assessment of Educational Progress, found that "there appeared to be a positive relationship . . . between students' perceptions of mathematics and their proficiency in the subject" (p. 116). The results indicated that those children with higher proficiency levels in mathematics tended to display more positive attitudes about their ability in mathematics than children with lower proficiency levels.

#### Development Of Attitudes Towards Mathematics

Marshall (1989) has indicated that attitudes toward mathematics develop over time. This development begins with the reaction children have to mathematical experiences; their emotional response. An emotional response can include "a sense of frustration, a distrust of the child's own skills, or a general feeling of unease" (p. 50). These emotional responses towards mathematics can be triggered when children experience difficulty solving a problem. For example, the child may experience difficulty solving an addition problem and as a result become frustrated by his or her lack of success. The

frustration exhibited by the student is an example of an emotional response towards mathematics. An isolated case of this response to an addition problem in mathematics will probably make no lasting impression upon the child's attitudes towards the subject. It is when repeated instances of failure in mathematics and the related emotional reactions occur that a lasting negative attitude towards mathematics is likely to develop. Similarly, a child may experience a positive emotional response to a mathematical activity due to an experience of success. Repeated successful experiences are thus likely to develop into a lasting positive response towards mathematics. These lasting positive or negative responses to mathematics are known as attitudinal responses.

Marshall (1989) has suggested that the attitudinal response differs from the emotional response in that for the emotional response to occur the child has to be actively engaged in the activity, whereas the attitudinal response can occur independently. All that would be necessary to trigger the attitudinal response would be the presentation of a mathematics problem. "The child does not need to be engaged in solving the problem" (Marshall, 1989, p.50). The successful child would immediately display a positive attitude towards the task and the unsuccessful child a negative attitude towards the task. This immediate response is possible because the attitudinal response occurs as a result of "the activation of

previously stored affective memories" (Marshall, 1989, p. 50) about the activity. The child subconsciously remembers past positive or negative experiences with the activity or a similar activity and associates them with the current activity.

In this way, the attitudinal response the child exhibits towards mathematics is likely to indicate the success or failure experiences that child has encountered. Research has been conducted by Kifer (1977) to determine "How . . . consistent successful or unsuccessful achievement over time [is] related to the way students view themselves and their abilities" (p. 297). In a study comparing attitude and achievement levels of students in Years two, four, six and eight, two groups of students from each year level were selected. One group in each year was selected on the basis that it had a history of success, while the other was selected because it had a history of failure. A history of success was defined as being placed "in the top 20 per cent of their class every year of school attendance", whereas a history of failure was being placed in the bottom 20 per cent of the class each year (p. 300).

In the latter study, self-esteem, self-concept of ability (academic self-concept) and locus of control correlated significantly with academic achievement. The measure that produced the best relationship between academic achievement, achievement over time and student attitude, was the self-

concept of ability (academic self-concept) measure. Results from this measure indicated that

The successful and unsuccessful students in the second grade are virtually identical in terms of their perceptions of their abilities but by grade eight huge differences between those who have succeeded in the school setting and those who have not become evident. (Kifer, 1977, p. 305)

The Kifer study found that all students in Year two, regardless of previous success or failure in academic subjects, scored high on the academic self-concept measure. Scores for the Years four to eight found differences between successful and unsuccessful students with successful students displaying a high level of positive academic self-concept and unsuccessful students displaying negative academic self-concepts. The higher the grade level, the more pronounced the differences between the academic self-concepts of the successful and unsuccessful students. The findings indicated that the differences in scores were a result of a decrease in positive attitude by unsuccessful students. "The successful students . . . change little in their perceptions over the six grades" (Kifer, 1977, p. 305). The results of the Kifer study suggest that students "come to the school setting with extremely positive views" (p. 305) and it is the classroom experience that either

reinforces or reduces those views of ability depending upon the level of success experienced by the student.

A study concerning the differences in attitudes towards mathematics over time was also conducted by the National Assessment of Educational Progress (Lindquist, 1989). Subjects studied were lower primary (Year 3), upper primary (Year 7) and secondary school children (Year 11). Swafford and Brown (1989) reported this research and found that a difference in attitude toward mathematics was evident among the three grades being studied.

Differences in attitude among the three grades were found in mathematics-related affect and mathematics self-concept. In the research, the first attitude variable measured student enjoyment of mathematics (mathematics-related affect). Results showed that "99 percent of the 7th-grade students and 50 percent of the 11th grade students said they enjoyed mathematics" (Swafford & Brown, 1989, p. 110). Again, a decrease in positive attitude towards mathematics over the grade levels was evident in these results.

Attitude measures for the third and seventh grade students were not compared so it is difficult to ascertain whether a significant difference in student attitude existed between these groups. It is likely however that differences do exist since the grade seven students have completed four more years of mathematics education than the grade three children,

thus allowing time to develop stronger attitudes towards the subject (whether these be positive or negative).

The findings on the second attitude dimension (academic self-concept) showed that

Overall, the elementary students expressed a much more positive attitude than the high school students. As many as 30 percent more said it was true that they were good at working with numbers and they were willing to work hard to do well in mathematics. (Swafford & Brown, 1989, p. 111)

Results showed an overall decline in attitudes towards mathematics across the grade levels. These results suggest that between the grades 7 and 11, children encounter situations that result in reduced levels of positive attitude towards mathematics. These differences in attitude towards mathematics among the grade levels indicates the influence of attitudes development over time. This suggests that children who have been exposed to success or failure for longer periods of time will have stronger attitudes towards mathematics than children who have less experience with success or failure. The success or failure a student experiences with a task is likely to affect the way they view their ability in mathematics.

### Success/Failure Experiences And Their Effects On Student Academic Self-concept

Dweck (1986) also noted that there is a direct relationship between success and failure experiences and the development of academic self-concept. This relationship is seen as a result of a reciprocal influence in which academic self-concept is influenced by previous success or failure, which influences the approach the student has towards the task, which in turn influences the opportunity the student has for future success.

Dweck identified two alternate motivational patterns that occur as a result of the student's previous success or failure. The first approach is "characterised by challenge seeking and high, effective persistence in the face of obstacles" (p. 1040) and is termed an adaptive motivational pattern. Children with this approach to learning display a positive attitudinal response towards the task and a high academic self-concept, which results in a greater opportunity to achieve success. This chance for success is due to the fact that students with adaptive motivational patterns view difficulties as challenges rather than obstacles. "Children displaying this pattern appear to enjoy exerting effort in the pursuit of task mastery" (p. 1040) and as a result of this effort are more likely to succeed in the task.

The second pattern of motivation is termed a maladaptive motivational pattern and is "characterised by challenge avoidance and low persistence in the face of difficulty" (p. 1040). Children with this pattern display negative attitudinal responses towards the task and low academic self-concepts. They approach a task with little faith in their ability to succeed and as a result experience difficulty in challenging situations. They "tend to evidence negative affect (such as anxiety) and negative self-cognitions when they confront obstacles" (p. 1040).

Children may have marked differences in achievement levels as a result of these different motivational patterns. Dweck (1986) points out that differences in achievement are not necessarily an indication of student ability, rather they are an indication of student motivation to succeed with the task (p. 1041). The motivated child will persist with tasks for a longer period of time resulting in increased opportunity for success. This allows the cycle of success, positive affect and adaptive motivational pattern to continue. The unmotivated child on the other hand will be less likely to persist, thereby reducing his or her chances of successfully completing the task. A cycle of failure, negative affect and maladaptive motivational pattern is then initiated.

The influence of motivational patterns on student achievement is particularly important for children who have

consistent patterns of failure with mathematical tasks. This theory suggests that children with learning problems in mathematics may not necessarily lack the ability to do well in the subject, they may simply have their chances of success reduced due to a maladaptive motivational pattern caused by a negative mathematics self-concept. Since repeated experience with success correlates with positive attitudes towards mathematics and repeated experience with failure correlates with negative attitudes towards mathematics, it may be assumed that children with learning problems in mathematics will have more negative attitudes than children without learning problems in mathematics.

Chapman (1988b) has gathered data to indicate that success or failure in school is influenced by factors other than an individual's cognitive abilities. He supports the motivational processes theory by stating that "successful students usually enter new learning tasks with positive motivational and social-emotional attitudes, whereas failure-prone students frequently approach learning events with negative feelings" (Chapman, 1988b, p. 357). Chapman set out to determine whether a history of failure in children termed learning disabled was associated with a decrease in academic self-concept, achievement expectations and locus of control.

Chapman studied a group of Year six children, 78 of whom were LD (learning disabled) and 71 NLD (non-learning

disabled). After identification by a number of assessments including IQ scores and Progressive Achievement Tests in four subjects, the students completed an attitude questionnaire.

Results of the questionnaire indicated that the LD and the NLD groups differed significantly in terms of their academic self-concepts. The NLD groups reported significantly higher academic self-concept scores than the LD group. LD students were also found to have a more internal locus of control than the LD students in that they ascribed "more responsibility to ability for successful events". The LD groups tended to ascribe success to external factors such as an easy task or teacher assistance. The LD group also indicated that their expectations for future achievement were lower than those of the NLD group. Overall, the LD children had far more negative perceptions of their abilities than the NLD children.

Chapman's research (1988b) indicated that in all aspects of the study, the self-concept of LD children did not become increasingly negative over time. Chapman found that rather than decrease, the academic self-concepts of the LD children became increasingly stable over time and it was the self-concepts of the NLD students that were inconsistent.

The overall results of the research indicate that Learning Disabled children appear to have a distinctive and different set of affective characteristics in comparison with normally achieving children. These

characteristics are marked by low self-perceptions of ability, reflecting relatively negative academic self-concept, along with tendencies toward learned helplessness and lower expectations for future success in school. LD children therefore have relatively little confidence in their ability and expect to achieve at lower levels, but when success does occur, they see it as being caused by a teacher's assistance or easy work. (p. 363)

In a related study, Chapman (1988a) reviewed research relating to the academic self-concept of children he termed learning disabled (LD) and non-handicapped (NH) and found that all studies that obtained data on specific academic self-concept measures found "significantly lower scores for LD students compared to NH students" (p. 353). Results found that LD students' general self-concepts approximated their NH peers general self-concepts, but their academic self-concept differed significantly (p. 362).

One reason proposed by Chapman (1988) for the differences between the academic self-concepts of LD and NH students and the similarities between the general self-concepts of LD and NH students was that "satisfaction and feelings of accomplishment in sport, music, and hobbies . . . may help compensate for academic failure and prevent substantial decrements in general self-concept" (p. 363) for the LD children. Academic self-concept, relates specifically to

academic tasks and lack of success in this area cannot be compensated for by success in other unrelated activities.

Another important finding made by Chapman is that the self-perceptions of LD students were consistent over time. This finding is contrary to that of Kifer (1977), who found that differences in self-concept between LD and NH students were a result of a decrease in the positive self-concepts of children with learning problems rather than an increase in positive self-concepts of children without learning problems. Chapman's analysis shows that the self-concepts of LD children were consistent over time from Year three onwards (p. 364). He suggests that a possible reason for this is that the students may reach a "base point" (p. 364) after which further failures cease to have any major impact upon student self-concept. He does not indicate whether the differences in attitudes between the LD and NH children remain consistent throughout the grades or whether the NH children's attitudes become more positive over time compared with those of the LD children.

The results of the studies reviewed by Chapman indicate that the typical child with learning problems has an academic self-concept score at the 19th percentile (p. 353). Due to the fact that "people who hold positive self-perceptions usually try harder and persist longer when faced with difficult or challenging tasks . . . [and] students who feel relatively worthless and ineffectual tend to reduce their effort or give up

altogether when work is difficult" (Chapman, 1988, p. 347) it can be seen that children with low self-concepts about mathematics may have their learning problems intensified due to a lack of persistence and effort resulting from their negative attitudes.

A study by Winne, Woodlands and Wong (1982) also identified differences in academic self-concept among LD, normal and academically gifted students in grades four to seven. The students in this study were grouped according to results on two achievement tests and were identified by their teacher as either learning disabled, normal or gifted in terms of their mathematical ability. The children identified as LD on the basis of these measures were found to have normal intelligence scores and it was their lack of achievement that differentiated them from the normal and gifted academic groups.

The students completed two tests designed to measure self-concepts. The first, entitled "The Coopersmith Self-Esteem Inventory" (Winne, Woodlands & Wong, 1982, p. 471) measured general, peer-related, home and academic self-concepts. The second "The Sears Self-Concept Scale" (Winne, et. al., 1982, p. 471) measured student self-concept in relation to peers.

The results of this research showed "consistent, statistically reliable differences among the three groups of students in terms of academically labelled self-concept

subscales" (p. 473). It was found that the LD students' academic self-concepts were significantly lower than the normal and gifted students' academic self-concepts. Like Chapman, they found no reliable differences among groups on the home and general self-concept subscales. Winne, Woodlands and Wong (1982) suggest that the LD students may in fact have higher self-concepts in social and physical areas than the gifted students (p. 474).

#### Gender Differences In Student Attitudes

Studies have been conducted on gender influences, student attitudes and student achievement in mathematics.

Meyer and Fennema (1992) found differences between males and females in terms of attitude towards mathematics. One differentiating aspect of attitude towards mathematics is identified by Meyer and Fennema as confidence versus anxiety. Confidence is defined as "a belief that one has the ability to learn new mathematics and perform well on mathematical tasks, while anxiety is just the opposite" (Meyer & Fennema, 1992, p. 446) and has been found to be strongly related to achievement. Used in this way, the term mathematics confidence equates with mathematics self-concept. It is whether children view themselves capable or incapable of solving mathematical problems.

Meyer and Fennema (1982) found that "boys were more confident in their abilities to deal with mathematics than were

girls" (p. 446). These differences are the opposite of those found by Chapman (1988) whose results indicated that it was the girls who had more positive attitudes towards mathematics than the boys.

Meyer and Fennema (1982) also refer to causal attributions and locus of control in this context. Success can be attributed to luck, ability, effort or task difficulty (p. 446). Students who attribute success to ability or effort (internal locus of control) will be more likely to show greater persistence in the future due to increased expectations of success. Students who attribute success to luck or an easy task (external locus of control) will be less likely to expect success in the future and will not be persistent in trying to achieve it. In their research, Meyer and Fennema found that girls more than boys "exhibit an attributional style that inhibits persistence and other achievement-related behaviours" (Meyer & Fennema, 1982, p. 448). For the girls, this results in less persistence when faced with a difficult task and less opportunity for success.

Wigfield (1988), suggests that children's attributions for achievement have a significant effect on future achievement, motivation and academic behaviour. These attributions are made in terms of success and failure in a subject. "Attributing success to one's ability and failure to lack of effort promotes positive achievement motivation and behaviour, whereas attributing success to external factors such as task ease and

failure to lack of ability has negative consequences" (Wigfield, 1988, p. 76).

Meyer (1989) also found differences between males and females in terms of their attitudes towards mathematics. These attitudes were again measured in terms of student confidence with performing mathematical tasks and learning new mathematics (mathematics self-concept). Meyer (1989) indicates that "research on this variable has shown that males generally express higher confidence than do females, even when no achievement differences are present" (p. 156). Males tended to rate themselves higher than females when asked how good they were at mathematics and even when the females' academic achievement bettered that of the males, their self-perceptions of their ability was usually lower.

These attitudinal differences were also found to vary with the age of the subjects in the study. For example, differences were found between the attitudes of Year 7 and 11 boys and girls but no differences were found between the Year three boys and girls.

Marsh, Smith and Barnes (1985) disagree with these findings and state that in terms of total self-concept there appears to be little difference between the sexes. The only differences that do exist appear to be "in particular dimensions of self-concept that are consistent with sex stereotypes" (Marsh, Smith & Barnes, 1985, p. 583). These differences

include self-concept of leadership abilities and sociability characteristics in girls and boys. It is not until the upper grades of primary school that differences in mathematics self-concept between the sexes becomes evident. They suggest that all students' self-concepts decline as they go through high school but that this occurs sooner for girls than it does for boys due to stereotyping. This decline in self-concept towards mathematics has no relation to academic achievement because it has been found to occur even when the achievement levels of girls and boys are equal.

#### Summary

The results of these studies indicate that when determining factors that influence student academic achievement in mathematics, both cognitive and affective factors need to be considered. Affective factors are an important consideration because positive attitudes towards mathematics were found to enhance achievement in mathematics and negative attitudes were conducive to failure. The literature indicates that achievement and attitudes represent a reciprocal relationship in which success may enhance achievement which in turn may increase the chance for success. The evidence suggests that the longer students are exposed to success or failure in mathematics, the more their attitudes towards the subject consolidate in either a negative or positive way.

The development of attitudes towards mathematics was found to occur over time. Students experience an emotional reaction to mathematics which, with repeated experiences, develops into an attitudinal response. The more success experienced in mathematics, the more positive students attitudes became towards the subject. Students with histories of failure in mathematics were found to have developed stronger negative attitudes towards the subject over time.

Evidence presented by researchers suggest that this relationship between attitude and achievement is due in part to the motivational orientations of the different groups. Successful students were found to exhibit adaptive motivational patterns which increased the opportunity they had for further success and unsuccessful students had maladaptive motivational patterns likely to result in further failure. These motivational patterns developed as a result of past experience with success or failure.

There was conflicting evidence as to whether or not attitudes towards mathematics differed according to the gender of the student. The differences in these findings were evident in the measures used to determine gender differences. Gender differences were not evident when the general self-concepts of males and females were assessed but when assessed in terms of academic self-concept, males were found to have higher self-concepts than females. Males were also found to be more

confident in their ability to be successful and had attribution beliefs that were conducive to success.

## CHAPTER III

### Methodology

This chapter will discuss the design of the study, give an outline of the relevant independent and dependent variables and provide details on the subject selection procedures. The chapter includes a description of the instruments used and the ways in which data were collected and analysed. Hypotheses are listed at the end of the chapter.

#### Design Of The Study

A three by two factorial research design was used to investigate the hypotheses. The first independent variable (Factor A) was designated as the achievement group's factor (three levels).

The achievement groups were classified as follows

- (i) children with learning problems in mathematics (Yr 7LP)
- (ii) equal-chronological age successful regular class children (Yr 7SN)
- (iii) young-chronological age regular class children (Yr 5N).

Two single-degree of freedom contrasts were effected. The group comprising the Year seven children with learning problems in mathematics (Yr 7LP) was compared with the equal-chronological age successful regular class group (Yr 7SN)

and the Yr 7LP group was then compared with the young chronological-age regular class group (Yr 5N).

The second independent variable (Factor B) was gender (two levels). Male and female students were compared on the relevant dependent variables. One single-degree of freedom contrast was effected.

The three dependent variables were designated as measures of the following attitude domains.

- (i) Mathematics self-concept (MSC)
- (ii) Mathematics-related affect (MRA)
- (iii) General school-related affect (SRA)

### Subjects

Subjects were selected from seven Western Australian primary schools in the same general geographic area. Year seven and Year five students were randomly selected from a sample of lower to middle class schools in Perth's southern suburbs. All students in these classes were assessed and six groups in a 3x2 factorial design were identified from the sample. Three students were omitted from the total sample. Two of the students were omitted due to their limited understanding of English and one student failed to complete the attitude scales correctly. A sample size of 30 subjects per group was randomly selected from the population of students tested.

A group of 30 males and 30 females was identified for each of the achievement levels, thus resulting in six achievement groups in all. The first group comprised Year seven boys with learning problems in mathematics (Yr 7LP males), identified as those scoring at or below the 25th percentile on the Progressive Achievement Test in Mathematics (PAT maths, Australian Council for Educational Research). The second group comprised girls selected from the same classrooms who also scored at or below the 25th percentile on the same test (Yr 7LP females). The third and fourth groups consisted of boys and girls, respectively, from Year seven classrooms whose mathematics achievement scores were at or above the 50th percentile (Yr 7SN males and Yr 7SN females) as identified by the PAT Maths tests. Groups five and six were made up of boys and girls from Year five classrooms (Yr 5N). The average mathematical achievement scores of these students were at comparable levels with those of the Yr 7LP male and Yr 7LP female groups (see Table 1). The children in the Year seven sample that fell below the 50th percentile and above the 25th percentile were omitted from the study.

### Instruments

The instruments used in this study included the Progressive Achievement Tests in Mathematics (PAT maths-level 2A) and an attitude scale. The PAT maths tests (Australian Council for Educational Research, 1984) are

**Table 1****Subject data**

<b>Level</b>	<b>Average age</b>	<b>Average PAT maths scores*</b>
Yr 5N males	10 years 0 months	16th percentile
Yr 5N females	9 years 9 months	18th percentile
Yr 7SN males	12 years 0 months	70th percentile
Yr 7SN females	11 years 9 months	71st percentile
Yr 7LP males	11 years 7 months	13th percentile
Yr 7LP females	11 years 9 months	14th percentile

\* All PAT (maths) scores were converted to percentiles using the Year 7 standardised percentile rankings.

standardised norm-referenced tests, the aim of which is to "assist teachers in determining the level of achievement attained by their students in the basic skills and understandings of mathematics" (p. 1). Three levels of the tests are available for use with students from the Years three to eight with two equivalent versions of each test being available. Level 2A was chosen for this study since it may be used to test both Year five and Year seven students. This level tests students' skills and understandings in the topics number, computation, fractions, measurement and money, statistics and graphs, spatial relations and logic and sets. It was possible to

compare the results of the groups for the purposes of this study by converting the raw scores into Year seven norm-referenced percentile rankings. This allowed students to be placed into the specified groups according to achievement level.

The attitude scale was developed by the researcher and consisted of three separate questionnaires. These questionnaire were:

- (i) Mathematics self-concept questionnaire
- (ii) Mathematics-related affect questionnaire
- (iii) General school-related affect questionnaire

Each questionnaire comprised six pairs of linked questions (See Appendix A (ii), (iii) and (iv)), based on magnitude scaling principles (Lodge, 1981).

Magnitude scaling is a measurement technique used to "determine the direction and strength of people's beliefs and preferences" (Lodge, 1981, p. 5). Magnitude scaling was used because unlike category scaling (eg. Likert scales), it offers the subject an almost unlimited range of possible responses. Category scaling involves subjects' responses being placed within specified categories that are set previously by the researcher, whereas magnitude scaling allows the subjects to set their own criteria for answering the questions.

Subjects set their own criteria by drawing a reference line. Each reference line sets a personal standard with respect

to a specified stimulus question. "What is characteristic of the magnitude estimation procedure is that all judgements are made explicitly relative to a reference, typically, to a low-intensity or middle-level stimulus" (Lodge, 1981, p. 8). It is also very important that the stimulus used is well known to all subjects in the study.

In the current study the cartoon character Bart Simpson was chosen as the standard from which the reference line was to be drawn. This was done due to the fact that most Australian children are familiar with the character and his characteristics. Using this cartoon character as a basis for the stimulus question, a question likely to result in a low to mid-level response from subjects for the reference line is "How much does **Bart Simpson** like mathematics?". The students then determine their responses to this question and draw the reference line from the given starting point (see Figure 3).

A second question asks the subjects to draw a response line to "express the strength of their position relative to the reference line" (Lodge, 1981, p. 61). The question relating to the stimulus question indicated earlier is "How much do **you** like mathematics?". The students again determine their responses to the question and draw the response line, but in this instance the responses are determined relative to the reference line. For example, if the subjects' responses to the second question were stronger than that for the stimulus

question, the response line would be drawn longer than the reference line. A weaker response would necessitate a shorter response line and "subjects holding a middle position on the issue would draw a response line equal to their reference line" (Lodge, 1981, p. 61). Subjects' responses may therefore range from one end of the continuum to the other depending upon the strength of their attitude in relation to the first line they drew. Logarithmic transformations (Log response line-Log reference line) are routinely used to measure strength of attitudes to specific stimuli.

Figure 3 demonstrates how the subjects would draw a reference line and then a response line to respond to both the stimulus question and the subsequent question. If the first line in this example represents how much Bart Simpson likes mathematics and the second line indicates how much the student likes mathematics then it can be said that the student likes mathematics approximately twice as much as Bart Simpson.

Magnitude scaling in its truest sense involves drawing the reference line in terms of the degree to which the "average" person likes mathematics. Since this research dealt with young children, it was considered more reliable to choose a reference that was less subjective and less open to biased interpretation.

The responses made by each subject were analysed by measuring the length of each line and recording the respective

lengths in millimetres. A transformation was then effected on the data to enable a numerical score to be obtained. The transformation was conducted by first determining the log of the reference line and the response line. A logarithmic transformation (log response line - log reference line) was then used to determine the relative strength of each student's attitude.

This procedure resulted in a numerical allocation for each pair of questions. The results were then averaged to allow one numerical value to be assigned to each questionnaire. These scores allowed comparisons to be made among groups of subjects.

A pilot study was conducted to test the reliability of these questionnaires. Transformation data were used in the analysis and the results of this study were analysed by Cronbach's (1951) alpha coefficient and were as follows

Mathematics self-concept questionnaire	.9387
Mathematics-related affect questionnaire	.8245
Mathematics-related affect questionnaire	.8210.

These results showed that all three questionnaires were highly reliable. It was judged that content validity was also high given the unambiguous nature of the questions in the scale and the close link they had with mathematics content. The importance of content validity is indicated by Kim and Hunter (1993) who found evidence to suggest that "construct-valid"

**Reference line**

1. How much does Bart Simpson like maths?

o -----

**Response line**

2. How much do you like maths?

o -----

**Figure 3.** Magnitude scaling: Subject response to stimulus question and related question.

attitudes have directive influences over behaviour. Hence, we can unravel the mystery surrounding prediction and explanation of specific action tendencies by turning our attention to construct-valid attitudes that correspond precisely to the particular action tendency of interest" (p. 130). The attitude scales used in this study were considered valid since they reflected this conceptual match between attitude and behaviour. The scales measured specific student attitude in relation to mathematics, and would therefore be considered by Kim and Hunter (1993) to have attitudinal relevance. The mathematics self-concept and mathematics-related affect scales would be considered to have higher construct validity than the school-related affect variable.

**Research Design**

The three dependent variables were ordered in the following way: mathematics self-concept, mathematics-related

affect, and school-related affect. This was done so that a step-down F analysis could be conducted to determine the relative importance of each dependent variable to differences among groups. Stevens (1992) states that "stepdown analysis requires an a priori ordering of the dependent variables, [and] there must be some theoretical rationale or empirical evidence to dictate a given ordering" (p.363). The empirical evidence for the current study is proposed by Bloom (1976) who found that for grades five and above the correlation between achievement and academic self-concept was .50 (p. 94); between achievement and subject-related affect .31 (p. 85) and between achievement and school-related affect was .25 (p. 92). A stronger correlation between achievement and academic self-concept was indicated by Bloom (1976) than that between achievement and either subject-related affect or school-related affect. Further, Bloom's data suggests that the academic self-concept in mathematics variable may account for most of the shared variance (an estimate of 25% of variance for the composite affect variables) and that the other two variables (subject- and school-related affect) may not make a significant contribution after the self-concept variable has been partialled out. The variables were rank ordered from highest to lowest priority following suggestions by Tabachnick and Fidell (1989). The highest priority was considered to be mathematics self-concept since Bloom (1976) indicated that this was the

variable with the "strongest" correlation with academic achievement. The aim of the current study was to determine if this relationship exists for mathematics achievement and mathematics academic self-concept for regular class children and children with learning problems. Kim and Hunter (1993) indicated in their meta-analysis that the degree of relationship between attitude and behaviour is .79 for adult subjects when the scales contain attitudinal relevance (p. 123). This again suggests that the school-related affect variable may be less important in differentiating groups since this has the lowest construct validity of the three variables.

#### Data Collection Procedures

Mathematics achievement was determined by administering the PAT (maths) tests to all children. The standardised format, detailed in the test package, was used to administer the tests. The levels of mathematical achievement of all children were then identified by converting each child's raw score into a percentile rank using the Year seven standardised data. Year five children were scored using the Year seven standardised percentile rankings to allow comparisons to be made between the Year seven children with learning problems and the Year five regular class children.

Three attitude scales were given to each child. A practice sheet and an identical explanatory poster were used to allow the children to become familiar with the questionnaire format.

A brief overview of the instructions given during this introductory stage are given below. For the exact instructions used see Appendix B. The student questionnaire is shown in Appendix A.

The children were asked to indicate whether or not they knew the cartoon character Bart Simpson. Results indicated that all children in the study knew this character. The appeal of the character added weight to the view that responses would be answered relative to a stimulus the subjects considered "relevant". Kim and Hunter (1993, p.115) stress the importance of relevance between the attitude measure and the behaviour being studied. Relevance is important so that a relationship between attitude and mathematics achievement behaviour can be accurately determined.

The children were given two practice questions to familiarise them with the magnitude scaling procedure. These practice questions were 1a) " How much does **Bart Simpson** like listening to the radio?" 1b) How much do you like listening to the radio?" and 2a) "How much does **Bart Simpson** like watching T.V.?" and 2b) "How much do you like watching T.V.?". For the first question, the children were told to think about how much Bart Simpson liked listening to the radio. The magnitude scaling procedure was then explained and demonstrated by the researcher on the explanatory poster at the front of the class. The explanation was as follows. "Look at

the poster at the front and I will show you what to do. If I think he likes listening to the radio a lot, I rule a long line from the circle (left to right). If I think he doesn't like listening to the radio at all, I rule a short line from the circle. If I think he's somewhere in between, I rule the line as long or as short as I need to show how much Bart Simpson likes listening to the radio but I DON'T GO TO THE EDGE OF THE PAPER." The children were then directed to draw their own reference line for Question 1a.

Children were then asked to think about how much they liked listening to the radio compared to how much Bart Simpson liked listening to the radio. They were told that if they liked listening to the radio more than Bart Simpson, they were to rule a line longer than the first line they ruled, if they liked it less, they were to rule a shorter line. They were told "Again, I rule my line as long or as short as I need, to show how much I like listening to the radio compared to how much Bart Simpson likes listening to the radio."

The children were then given time to ask questions and the researcher checked children's responses to ensure all children understood how to answer the questions. The questionnaires were then completed with each question being read aloud by the researcher. The questions were read aloud to assist those children whose reading skills were not sufficient for them to answer the questions accurately on their own.

After the questionnaires were completed, the instructions were given for the mathematics test. This test was administered following the published standardised format.

#### Data Analysis Procedures

A step-down analysis (based on the multivariate model) and univariate analysis of variance were used to test the hypotheses.

#### Research Hypotheses

(1) Null Hypothesis Ho: That there will be no significant interaction between the factors of achievement level and gender. This hypothesis will be tested at the 0.05 level of significance.

In determining differences between groups, step-down F tests will be used to determine the relative importance of each dependent variable. The rank ordering of the variables (as determined by the empirical research) is as follows:

- (i) Mathematics self-concept
- (ii) Mathematics-related affect
- (iii) General school-related affect

(2) Null Hypothesis Ho: That there will be no significant difference between the achievement groups (Yr 7SN and Yr 7LP) on the school-related affect variable after partialling out the variables of mathematics self-concept and mathematics-related affect.

A step-down analysis will be used in this context. This hypothesis will be tested at the 0.05 level of significance.

Alternate Hypothesis H1: That there will be a significant difference between the achievement groups (Yr 7SN and Yr 7LP) on the school-related affect and mathematics-related affect variables once the mathematics self-concept variable has been partialled from the analysis.

The null hypothesis is supported by the literature and as such is considered to be the critical hypothesis in this study (Bloom, 1976).

(3) Null Hypothesis Ho: That there will be no significant difference between the achievement groups (Yr 5N and Yr 7LP) on the school-related affect variable after partialling out mathematics self-concept and mathematics -related affect.

A step-down analysis will be used in this context. The hypothesis will be tested at the 0.05 level of significance.

Alternate Hypothesis H1: That there will be a significant difference between the achievement groups (Yr 5N and Yr 7LP) on the school-related affect and mathematics-related affect variables once the mathematics self-concept variable has been partialled from the analysis.

Again, the literature supports the null hypothesis (Bloom, 1976).

(4) Null Hypothesis Ho: That there will be no significant difference between the achievement groups (Yr 7SN and Yr

7LP) on the school-related affect, mathematics self-concept and mathematics-related affect variables when these variables are considered univariately. These hypotheses will be tested at the 0.05 level of significance.

Alternate Hypothesis H1: That the Yr 7SN group will report significantly higher positive attitudes in terms of school-related affect, mathematics self-concept and mathematics-related affect than the Yr 7LP groups when these variables are considered univariately. These hypotheses will be tested at the 0.05 level of significance.

There is strong support for the alternate hypotheses in the research literature (Winne, et. al., 1982; Dweck, 1986 and Chapman, 1988).

(5) Null Hypothesis H0: That there will be no significant difference between the achievement groups (Yr 5N and Yr 7LP) on the school-related affect, mathematics self-concept and mathematics-related affect variables when these variables are considered univariately. These hypotheses will be tested at the 0.05 level of significance.

Alternate Hypothesis H1: That the Yr 5N group will report significantly higher positive attitudes in terms of school-related affect, mathematics self-concept and mathematics-related affect than the Yr 7LP groups when these variables are considered univariately. These hypotheses will be tested at the 0.05 level of significance.

Again, the alternate hypotheses is that which is strongly supported by the research literature.

## CHAPTER IV

### Data Analysis

The subjects in this study were given three scales, each of which related to one aspect of subject affect. The first related to student mathematics self-concept (MSC), the second to mathematics-related affect (MRA) and the third to school-related affect (SRA). The mathematics self-concept scale assessed how well the students thought they were doing in mathematics; the mathematics-related affect scale measured how much the students liked completing mathematics activities; and the school-related affect scale measured how much the students liked school as a whole.

Student responses were analysed according to achievement level and gender in relation to these three dependent variables. A correlational analysis was conducted to draw relationships among dependent variables. For the first factor (student achievement levels) there were Year seven successful normal (Yr 7SN), consisting of Year seven children whose achievement levels in mathematics were above average, Year seven learning problems (Yr 7LP), consisting of children whose achievement levels in mathematics were below average and Year five normal (Yr 5N), consisting of Year five students in the regular classroom whose achievement levels were

matched with those of the Yr 7LP students. The second factor compared male and female responses.

The results were analysed using stepdown F tests (SPSS-X User's Guide, 1988). The three dependent variables were rank-ordered from the highest to lowest priority. These "priorities are assigned to DVs according to theoretical or practical considerations" (Tabachnick & Fidell, 1989, p. 400). In the context of the current research, the rank ordering is based upon theory proposed by Bloom (1976) which indicates that academic self-concept is the highest order dependent variables followed by mathematics-related affect and then school-related affect. Once the priorities have been determined

The highest priority DV is tested in univariate ANOVA, with appropriate adjustment of alpha. The rest of the DVs are tested in a series of ANCOVAs; each successive DV is tested with higher-priority DVs as covariates to see what, if anything, it adds to the combination of DVs already tested. (Tabachnick & Fidell, 1989, p. 400)

Since the highest priority dependent variable in this study was deemed to be mathematics self-concept, this was given the first position in the hierarchy. Mathematics-related affect was given second-order ranking with MSC as covariate (MSC was partialled from the analysis) and school-related affect was given third order with MRA and MSC as covariates (partialled from the analysis). As with analysis of covariance, the last in

the last in the ordered series was examined first in the subsequent analysis. The aim is to proceed from the third order variable to the first order until a significant result is obtained. Alpha was set at 0.05 (as indicated in the set of hypotheses).

### Results

The mean results for each affect questionnaire are listed in Table 2 by level and gender, along with the accompanying standard deviations for each group (shown in brackets). These data are then depicted in Figure 4 which shows the composite results for both genders at each achievement level. These results will be analysed in relation to the research hypotheses.

Correlations among the three affect variables are shown in Table 3. The table depicts the correlations between mathematics self-concept (MSC) and mathematics-related affect (MRA); mathematics self-concept (MSC) and school-related affect (SRA); and mathematics-related affect (MRA) and school-related affect (SRA) for each cell in the design. All results except for two (Yr 5N male and Yr 7LP male) were significant at the .01 level. Results indicate relatively higher correlations between relevant variables for females than for males. The data suggest that for females it may be easier to predict any one affect score from another measure in the same domain. For example, knowing the mathematics self-concept

**Table 2**

**Means and Standard Deviations (in brackets) by Level and Gender for Three Affect Measures**

Level/Gender	MSC	MRA	SRA
(Yr 5N)			
Males	.55 (.70)	.62 (.65)	.90 (.56)
Females	.54 (.58)	.54 (.60)	.69 (.52)
(Yr 7SN)			
Males	.74 (.46)	.84 (.57)	.98 (.42)
Females	.76 (.54)	.67 (.48)	.94 (.56)
(Yr 7LP)			
Males	.35 (.38)	.38 (.37)	.46 (.40)
Females	.50 (.41)	.34 (.35)	.42 (.42)

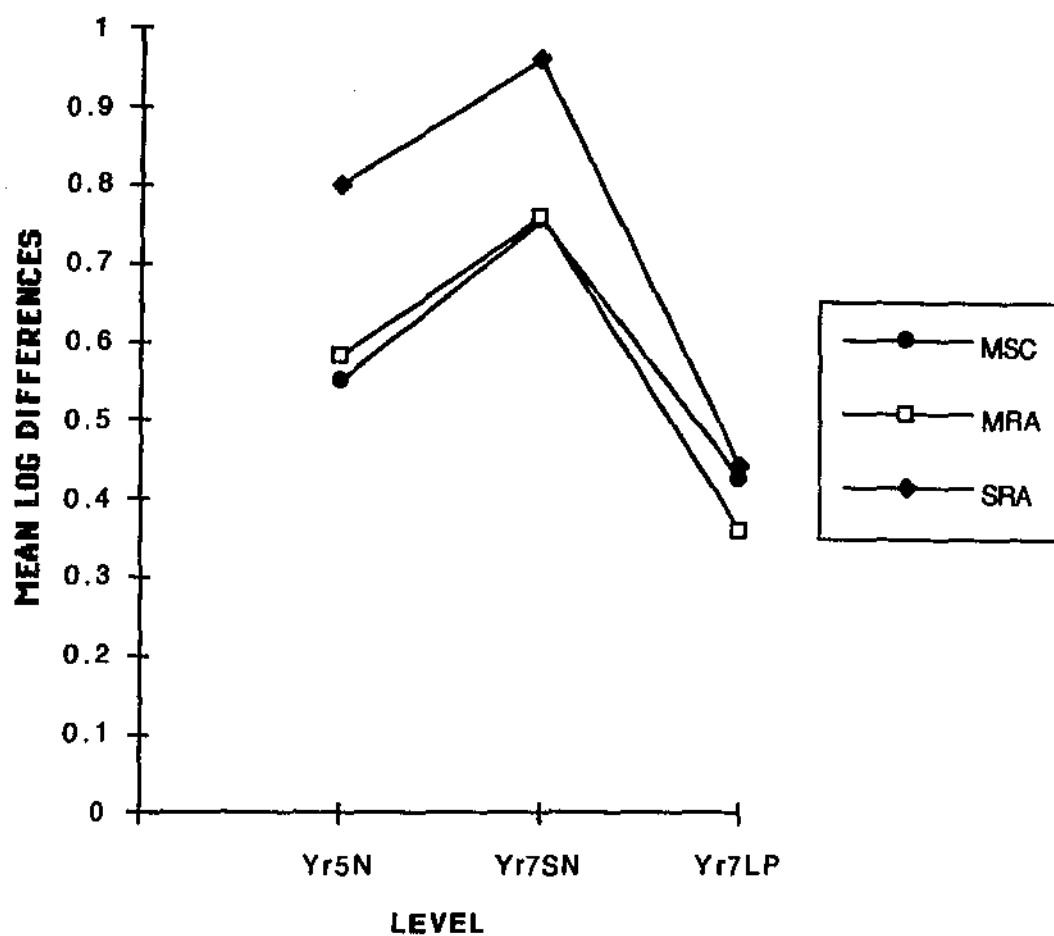


Figure 4. Mean differences among groups on three dependent variables (MSC = Mathematics self-concept, MRA = Mathematics-related affect, SRA = School-related affect).

Table 3

Correlation matrix depicting relationships among the dependent variables for each cell in the design

Level/gender	MSC vs MRA	MSC vs SRA	MRA vs SRA
Yr 5N male	.750	.402*	.486
Yr 5N female	.771	.786	.735
Yr 7LP male	.602	.426*	.484
Yr 7LP female	.666	.580	.715
Yr 7SN male	.520	.521	.507
Yr 7SN female	.920	.870	.891

\*Significant at  $p < .05$ . All other values were significant at the .01 level (two-tailed tests).

score for mathematics in the Yr 7SN female group allows both the mathematics-related affect and school-related affect scores to be predicted with a reasonable degree of accuracy.

For females this relationship is strongest for the Yr 7SN group, in which all correlations are above .85, and weakest for the Yr 7LP group. The affect scores for males did not result in such high correlations as those evident for females. The highest correlations for males were lower than the lowest correlations for females. This result suggests that subsequent affect scores for males may not be predicted as accurately as

those for females at least within the sample chosen for this study.

The hypothesis of initial importance is in respect of the interaction. Keppel (1991) defines an interaction to be "when the effects of one independent variable on behaviour change at the different levels of the second independent variable" (p. 196). The next section will discuss the findings for interaction between gender and level for the three dependent variables. The main effects (planned comparisons) will be discussed in the following section. Both planned comparisons (Yr 7SN and Yr 7LD) and (Yr 5N and Yr 7LD) will be discussed in terms of level and gender. Stepdown and univariate results will be analysed for each comparison and a summary of the outcomes of the study will be outlined.

#### Interaction (Achievement Level x Gender)

Figure 5 (Mean mathematics self-concept scores by level and gender) and Figure 6 (Mean school-related affect scores by level and gender) give the superficial impression of an interaction between level and gender. The responses appear inconsistent across all three achievement levels. In Figure 4 there appears to be a substantive difference between males and females in terms of mean responses to mathematics self-concept at the Yr 7LP level of achievement but not at the other levels. Figure 6 suggests a difference in mean responses to school-related affect at the Yr 5N level to those evident at the Yr 7SN and Yr 7LP levels.

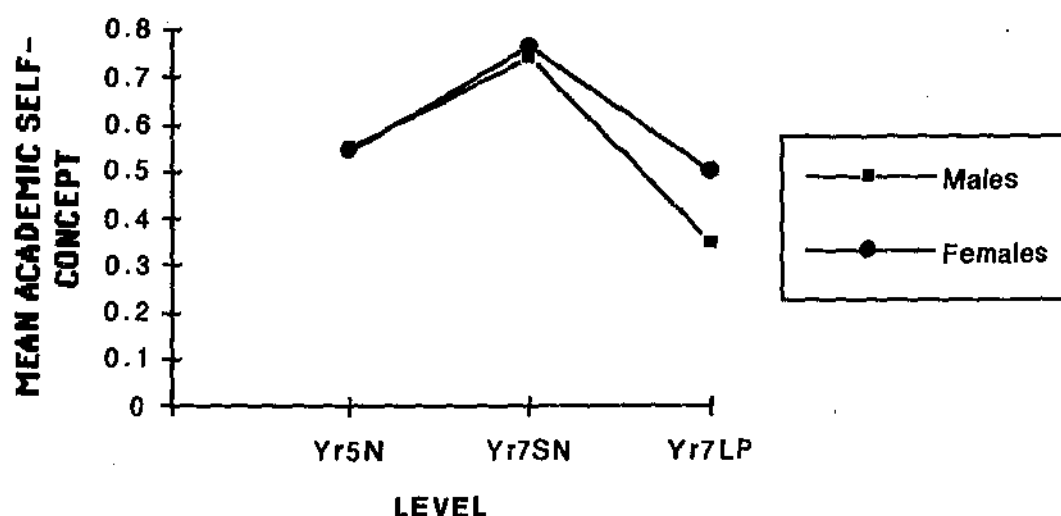


Figure 5. Mean mathematics self-concept scores by level and gender.school-related affect at the Yr 5N level to those evident at the Yr 7SN and Yr 7LP levels.

Despite the appearance of an interaction between level and gender, the multivariate test (Pillais criterion) revealed a non-significant ( $F(6, 346) = 0.56, p > .05$ ) effect. Subsequent analysis of the univariate results for each dependent variable also revealed non significant interactions (MSC  $F(2, 174) = .39, p > .05$ , MRA  $F(2, 174) = .23, p > .05$  and SRA  $F(2, 174) = .56, p > .05$ ). The absence of an interaction indicates that the first null hypothesis is supported. The relatively large standard deviations of the scores account for the non significant effect. The fact that no significant interaction was revealed allowed the main effects (planned comparisons) to be discussed without constraint.

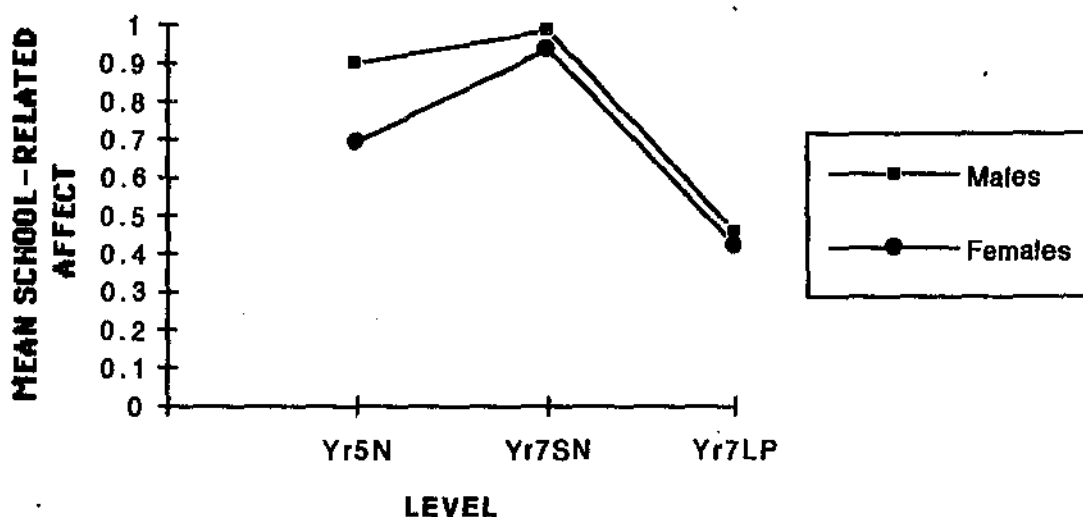


Figure 6. Mean school-related affect scores by level and gender.

Planned comparison:- Year 7 Successful Normal vs Year 7 Learning Problems Group

The first planned comparison compared the Yr 7SN and Yr 7LP groups. Results on the Roy-Bargman stepdown E tests indicated that significant differences were evident between groups when school-related affect was analysed with MRA and MSC as the covariates  $E(1, 175) = 14.88, p < .05$ . Significant differences were also evident in terms of mathematics-related affect when analysed with MSC as the covariate  $E(1, 176) = 5.95, p < .05$ . All relevant results are shown in Table 4. These results show that school-related affect and mathematics-related affect add significantly to the combination of dependent variables already tested. The second null hypothesis is therefore rejected.

Table 4

Analysis of Variance Comparing Yr 7SN and Yr 7LP.

Univariate F-tests with (1, 177) D.F.						
Variable	Hypoth.	Error	Hypoth.	Error	F	Sig.
	SS	SS	MS	MS		of F
MSC	3.24	48.68	3.24	0.27	11.78	.001*
MRA	4.75	47.24	4.75	0.26	17.78	.000*
SRA	8.08	42.05	8.08	0.24	34.02	.000*
Roy-Bargman Stepdown F-tests						
Variable	Hypoth.	Error	StepDown	D.F.	Sig.	
	MS	MS	F		of F	
MSC	3.24	0.27	11.78	(1, 177)	.001*	
MRA	0.79	0.13	5.95	(1, 176)	.016*	
SRA	2.00	0.13	14.89	(1, 175)	.000*	

\*Significant at  $p < .05$ .

The univariate F-test results were also analysed in the context of Yr 7SN and Yr 7LP groups. Results indicated that there was a significant difference between Yr 7LP children and Year 7SN children in terms of school-related affect ( $E(1, 177) = 34.02$ ,  $p < .05$ ), mathematics-related affect ( $E(1, 177) = 17.78$ ,  $p < .05$ ) and mathematics self-concept ( $E(1, 177) = 11.78$ ,  $p < .05$ ). It was hypothesised that the mathematics self-concept measure (MSC)

would differentiate the groups and that subsequent analysis (step-down tests using a series of ANCOVAs) would reveal non-significant differences between groups. Clearly, the opposite was revealed thus rejecting the fourth null hypothesis. There were reliable differences between groups on the school-related affect measure (SRA) after both MSC and MRA had been partialled and the mathematics-related affect measure (MRA) after MSC had been partialled from the analysis.

Planned Comparison: Year 5 Normal vs Year 7 Learning Problems Group

The second planned comparison compared the Yr 5N and Yr 7LP groups on the three dependent variables ranked hierarchically. Results on the Roy-Bargman stepdown E tests again indicated that when the differences between the two groups on school-related affect were analysed (with MRA and MSC as the covariates), the result was significant  $E(1, 175) = 12.05, p < .01$ . Significant differences were also evident between these groups in terms of mathematics-related affect ( $E(1, 176) = 3.98, p < .05$ ) (see Table 5).

These results reject the third null hypothesis in which it was stated that no significant differences would be evident between groups after the mathematics self-concept variable was partialled from the analysis.

Table 5

Analysis of Variance Contrasting Yr 5N and Yr 7LP.

Univariate F-tests with (1, 177) D.F.						
Variable	Hypoth.	Error	Hypoth.	Error	F	Sig.
	SS	SS	MS	MS		of F
MSC	0.46	48.68	0.46	0.27	1.66	.198
MRA	1.45	47.24	1.45	0.26	5.44	.021*
SRA	3.82	42.05	3.82	0.24	16.08	.000*
Roy-Bargman StepDown F-tests						
Variable	Hypoth.	Error	StepDown	D.F.	Sig.	
	MS	MS	F		of F	
MSC	0.46	0.27	1.66	(1, 177)	.198	
MRA	0.53	0.13	3.98	(1, 176)	.047*	
SRA	1.62	0.13	12.05	(1, 175)	.001*	

\*Significant at  $p < .05$ .

The univariate findings were analysed next. These results indicated a significant difference between groups in terms school-related affect ( $E(1,77) = 16.08, p < .05$ ) and mathematics-related affect ( $E(1,177) = 5.44, p < .05$ ). No significant difference was found between these groups in terms of mathematics self-concept ( $E(1,177) = 1.66, p > .05$ ). These results indicate that the fifth null hypothesis is partially rejected.

### Gender

When the dependent variables were analysed in a multivariate sense, differences between males and females were evident. This indicated that when all three affect measures were assessed multivariately, the eighth hypothesis was supported. Males generally displayed more positive attitudes than females ( $F(3, 172) = 0.04, p < .05$ ).

Univariate analysis however, revealed non-significant differences on mathematics self-concept  $F(1, 174) = 0.47, p > .05$ ; mathematics-related affect  $F(1, 174) = 1.44, p > .05$  and school-related affect  $F(1, 174) = 1.68, p > .05$ . This indicates that when mean scores for gender were taken univariately there were no significant difference between males and females in terms of affect.

### Summary

No interaction existed between level and gender. This allowed the main effects to be analysed without constraint.

For the first planned comparison between Yr 5N and Yr 7LP groups, the step-down results indicated significant differences in terms of school-related affect after mathematics self-concept and mathematics-related affect had been partialled out. Similarly, when mathematics self-concept was partialled from the analysis, the groups differed significantly in terms of mathematics-related affect.

When assessed univariately on these measures, significant differences were found between Yr 7SN and Yr 7LP children in terms of their attitudes towards school (SRA), their attitudes towards mathematics (MRA) and their attitudes towards themselves and their ability to achieve in mathematics (MSC). The Yr 7SN group were found to have significantly higher positive attitudes in all three areas than the Yr 7LP group.

The findings for the Yr 5N and Yr 7LP groups were similar to those for the Yr 7SN and Yr 7LP groups. Significant differences were evident on the school-related affect and mathematics-related affect variables after the preceding variables had been partialled from the analysis. Differences between groups were also evident for school-related affect and mathematics-related affect when these variables were assessed univariately. Taken univariately, no significant difference was found between groups in terms of the mathematics self-concept measure.

For both comparisons, no significant difference was found for gender on individual affect measures.

The results indicated that when analysed univariately, all three affect variables are significant in differentiating between groups. Step-down results added to this finding in that school-related affect was found to add significantly to the explanation of differences between groups after mathematics-related affect

and mathematics self-concept had been partialled from the analysis.

## CHAPTER V

### Discussion

Bloom's model of learning (1976) was used as the framework for this research. The focus was on the relevant affect variables and their influence on school learning. These variables were mathematics self-concept, mathematics-related affect and school-related affect and were used in relation to mathematical learning tasks. The outcomes of the learning tasks were success and failure.

The primary objective of the study was to examine the affective responses of successful and unsuccessful students in mathematics. The students who had successful mathematical learning experiences were the Yr 5N (Year five normal) and the Yr 7SN (Year seven successful normal) groups and the students who had experiences of failure in mathematics were in the Yr 7LP (Year seven learning problems) group.

A strong correlation was shown to exist among the three affect variables. This means that mathematics self-concept, mathematics-related affect and school-related affect overlapped to a considerable extent. When assessing the students' responses in terms of their mathematics self-concept, their liking of mathematics as well as their liking of school in general will predict substantial variance in the other affect variables. Similarly, when assessing mathematics-related

affect and school-related affect, the two remaining variables will influence students' responses to a considerable extent. Results showed that the strength of these correlations differed somewhat between the achievement and gender groups. The affect variables revealed somewhat higher correlations for females than for males across all groups.

The initial objective was to examine the interaction among factors in the design. No significant interaction was found between the factors of achievement groups and gender in that the results for each affect variable for males and females were consistent across groups. The same pattern was evident for the Yr 5N males and females as that for the Yr 7SN and Yr 7LP males and females. The absence of an interaction allowed gender differences and group differences to be discussed without the constraint of the confounding effects of the other factor.

The primary aim of this study was to determine which of the three identified affect variables would be most significant in explaining affect differences between the Year seven successful normal students and Year seven students with learning problems and between the Year five normal students and Year seven students with learning problem.

Initially, an a-priori ordering of the three affect variables was made in accordance with criteria outlined by Stevens (1992). The variables were ordered with mathematics self-

concept placed first, followed by mathematics-related affect and lastly school-related affect. This rank ordering was effected on the basis of Bloom's research (1976). He found that the variable that best predicted student achievement in mathematics was the mathematics self-concept variable. The second best predictor variable was mathematics-related affect and the variable with the least predictive ability was school-related affect. This rank ordering was also consistent with the work of Kim and Hunter (1993) that gives priority to the variable with specific relevance to the task. Tabachnick and Fidell, (1989) suggested ranking the variables with the highest priority first, thus mathematics self-concept was ordered first in the analysis. School-related affect was thus analysed after mathematics-related affect and mathematics self-concept had been partialled from the analysis. Mathematics-related affect was then analysed with mathematics self-concept partialled out. In effect, a series of ANCOVA's were performed on the data.

The most important finding of this research is that there was a significant difference between the Yr 7SN and Yr 7LP achievement groups on the school-related affect variable after the other affect variables had been partialled out. This is contrary to the previous research findings detailed earlier in which mathematic self-concept was thought likely to account for most of the affect differences between groups. It was

thought that after the mathematics self-concept and mathematics-related affect variables had been partialled, school-related affect would not be needed to explain any further differences between groups. Clearly, this was not the case.

Subject-related affect was also found to be significant in explaining differences between the Yr 7SN and Yr 7LP groups. Like school-related affect, it was considered likely that this variable would not make a significant contribution to differences between groups after the self-concept variable had been partialled out. Again this was not the case with results showing that mathematics-related affect did differentiate between groups to a significant degree.

Univariate results for this comparison indicated that the Year seven children with learning problems in mathematics and the Year seven successful children differed significantly on all three affect variables when these were analysed univariately. When the variables mathematics self-concept, mathematics-related affect and school-related affect were analysed individually, it was found that the Year seven successful children had significantly higher positive attitudes towards all areas than the Year seven children with learning problems in mathematics. The successful children had higher levels of mathematics self-concept in that they had more confidence in their ability to achieve in mathematics and

exhibited a greater liking of mathematics and school in general than the children with learning problems in mathematics.

The results suggest that the mathematics-related affect and school-related affect variables are perhaps more important than suggested in other research (Bloom, 1976). It is evident from the results for the first comparison between Yr 7SN and Yr 7LP groups that simply assessing the students' mathematics self-concepts may not be sufficient in explaining affect differences between successful and unsuccessful students in mathematics. This research indicates that to gain a clearer insight into students' affective characteristics it is important to consider the attitudes these students display towards school in general as well as their attitudes towards mathematics.

The comparison between Yr 5N and Yr 7LP groups also produced significant results. Differences were found in terms of school-related affect after the effects of mathematics self-concept and mathematics-related affect had been partialled from the analysis. It had been hypothesised that school-related affect would not make a significant contribution to the differences between these groups after the mathematics self-concept and mathematics-related affect variables had been partialled. This was clearly not the case. Results indicated that the Year five children without learning problems had significantly higher levels of positive attitude towards school

than the Year seven children with learning problems in mathematics.

Subject-related affect was also expected to add little to the explanation of differences between the groups after the influence of mathematics self-concept had been partialled out. Again, this variable was found to be significant in differentiating the successful and unsuccessful groups.

The findings of this research indicated that like the comparison between Yr 7SN and Yr 7LP, there were significant differences between students in the Yr 5N and Yr 7LP groups in terms of mathematics-related affect and school-related affect when these variables were analysed univariately. The Year five children had significantly higher levels of positive attitude towards mathematics than the Year seven children with learning problems in mathematics. They also exhibited higher levels of positive attitude towards school than the Year seven children. One interesting finding was that there were in fact no differences between the Yr 5N and Yr 7LP groups in terms of mathematics self-concept. This was initially thought to be the most important variable in differentiating groups but for this comparison no differences existed. Results indicated that the Yr 7LP children liked school and mathematics less than the Year five children but had approximately the same level of attitude toward personal ability in the subject. The significance of this finding to the classroom teacher is considerable. These

students, although they have mathematics self-concepts that are lower than their successfully achieving peers, have self-concepts that are comparable to students performing at approximately the same mathematical level. This gives hope that the Year seven unsuccessful students' attitudes can be improved with assistance.

The results of the present study can be compared with the meta analysis conducted by Kim and Hunter (1993). Since the measurement instruments used in this study were considered attitudinally relevant (Kim & Hunter, 1993), the proposed links between student attitudes towards mathematics and their behaviours within the subject are supported. Kim and Hunter (1993) state that

- . Specifically, three conditions are necessary to expect that attitudes will be translated into actions. First, we must be sure that attitude scales are conceptually relevant to the behavioural components being predicted. . . .Second, we must exercise caution to ensure that the behaviour in question is toward the volitional side of the continuum [Subject have some control over their actions]. . . .Third, we should use proper measures of attitude and behaviour. (p. 131)

When these three conditions are present, the correlation between attitude and behaviour has been found to be as high as .79 (Kim and Hunter 1993). It may be that a lower order

correlation exists for younger subjects, possibly because of their relative lack of experiences in relevant areas.

Results suggest that the more students experience success in mathematics, the more positive their attitudes will be towards the subject and school in general (Bloom, 1976). Similarly, the more failure experiences students encounter, the more negative their attitudes will become towards mathematics and school. The present study is not a longitudinal study, rather a cross-sectional one, but even so the results are consistent with this interpretation.

Causal relationships cannot be substantiated in a comparative study but it seems reasonable to suggest that the differences between groups are a result of the reciprocal relationship between the affective entry characteristics and the learning outcomes associated with the task. The students in the learning outcomes group have experienced failure in mathematics (evidenced by their inclusion in this group) and reported low affect towards the subject and towards school. These negative affective entry characteristics influence the way in which the students approach the next learning task, which in turn influences the opportunity for success with the task. Successful students on the other hand reported higher levels of affect towards mathematics and school than the unsuccessful group. These students will approach the

mathematical tasks in a different manner and will subsequently have different opportunities for success.

These differences may be due in part to the motivational patterns outlined by Dweck (1986). The students in the successful groups would exhibit adaptive motivational patterns towards the task since this pattern of motivation is characterised by positive attitudes and high mathematics self-concept. The unsuccessful students would have a maladaptive pattern since this is characterised by negative attitudes and low mathematics self-concepts. Students with adaptive patterns will persist with a difficult task longer than students with maladaptive patterns, the result being that they are then given greater opportunity to achieve success in the task.

#### Significance Of the Results To Education

These findings indicate that for the teacher who has both successful and unsuccessful students in mathematics in an upper primary classroom, the differences in achievement between the students may be partly explained by affective variables. There are three important affect variables to consider when differentiating between these groups. The students who are successful in mathematics are likely to have positive attitudes towards their ability in mathematics and are likely to enjoy mathematical activities and school in general. They are said to hold positive mathematics self-concepts, mathematics-related affect and school-related affect. The

unsuccessful students in the class are likely to demonstrate feelings of inadequacy in mathematics and may dislike mathematics and school in general. They are said to have low mathematics self-concepts, mathematics-related affect and school-related affect.

What can the teacher do to assist those children who are unsuccessful in mathematics? More particularly, what can the teacher do to improve their attitudes in these three areas so that they may have greater opportunity for success in mathematics? First, the teacher can work on the mathematical task itself. Since the unsuccessful students are so named because they have limited experiences with success in mathematics, the teacher should attempt to provide situations in which success may be achieved. Success in mathematics can be provided through the manipulation of the mathematical task. The teacher should endeavour to present tasks in which the students are capable of achieving success. This involves manipulating the actual task so that the students are capable of completing it given their current level of academic achievement and background knowledge.

The second way in which student attitude towards mathematics can be improved is by working directly on their affective entry characteristics. This may be done by stressing that the students should have a positive attitude towards mathematics as well as a positive attitude towards school. The

teacher may point out that if they think positively about their ability to succeed and put in the effort, they will have a greater chance of being successful in mathematics. The teacher should be aware that a significant variable may well be that the students' attitudes to school in general will influence their achievement in mathematics.

Lastly, the students need to be taught that the way they think about their successes and failure will influence their subsequent ability to succeed. The children need to understand that failure in a mathematical task does not necessarily mean they are incapable of achieving success. A failure may mean that the task was a little too difficult or that they simply needed to try harder to complete the activity. The teacher is therefore encouraging the use of metacognitive strategies. Metacognition in this context is the "knowledge and monitoring of thinking and learning strategies (Woolfolk, 1987, p.258).

One difficulty for teachers is to provide a balance between the difficulty of the task and the students' abilities to achieve. This means that the task should be easy enough that the students are capable of succeeding whilst still providing a challenge so that students will perceive their successes as coming from their own actions (internal attributions of success) rather than the easy task. The importance of student perceptions of success and failure is seen in the way

mathematics self-concept develops. Mathematics self-concept develops as a result of the shift from external attributions of success, such as an easy task or assistance from the teacher, to internal attributions including effort and persistence (Bloom, 1976). A positive academic self-concept towards mathematics will develop through experiences with success that the student perceives to be due to personal effort. This means that to comply with the need of the students to attribute success to effort, the task provided by the teacher, although deemed easy enough that the children will be capable of completing it, should be difficult enough so that effort will result in success.

If students are given appropriate tasks, assistance in developing positive attitudes and are taught ways in which they can think about their successes or failures, is it possible that improved academic achievement in mathematics will result.

#### Limitations Of The Study

One limitation is that this is a correlational rather than a causal study. The relationships between the factors have been described but it cannot be said that one has caused the other. Future research may attempt to investigate this relationship further through a longitudinal study. Relationships between groups may also be studied through the investigation of other affect variables. Bandura (1986) suggests that perceived self-

efficacy may be an important variable through which to study this relationship.

### References

- Aiken, L.R. (1970). Attitudes towards mathematics. Review of Educational Research, 40(4), 551-596.
- Australian Council for Educational Research. (1984). PAT Maths: Progressive achievement tests in mathematics. Victoria: Australian Council for Educational Research.
- Australian Education Council. (1990). A national statement on mathematics for Australian schools. Victoria: Curriculum Corporation.
- Bandura, A. (1986). Social foundations of thought and action. A social cognitive theory. NJ: Prentice-Hall.
- Bloom, B.S. (1976). Human characteristics and school learning. NY: McGraw-Hill.
- Chapman, J. W. (1988a). Learning disabled children's self-concepts. Review of Educational Research, 58(3), 347-371.
- Chapman, J.W. (1988b). Cognitive-motivational characteristics and academic achievement of learning disabled children: A longitudinal study. Journal of Educational Psychology, 80(3), 357-365.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297-334.

- Dossey, J.A., Mullis, V.S., Lindquist, M.M., & Chambers, D.L. (1989). What Can Students Do? (Level of Mathematics Proficiency for the Nation and Demographic Subgroups). In M.M. Lindquist (Ed.), Results from the fourth mathematics assessment of the national assessment of educational progress. (p. 117-134). Reston, VA: NCTM.
- Dungan, J. F., & Thurlow, G. R. (1989). Students' attitudes to mathematics: A review of the literature. The Australian Mathematics Teacher, 45(3), 8-11.
- Dweck, C.S. (1986). Motivational processes affecting learning. American Psychologist, 41(10), 1040-1048.
- Keppel, G. (1991). Design and analysis: A researcher's handbook. (3rd. ed.). NJ: Prentive Hall, 196-197.
- Kifer, E. (1977). The impact of success and failure on the learner. Evaluation in Education: International Progress, 1(4), 283-359.
- Kim, M., & Hunter, J. (1993). Attitude-behaviour relations: A meta-analysis of attitudinal relevance and topic. Journal of Communication, 43(1), 101-142.
- Leder, G. (1992). Attitudes to mathematics. Mathematics Research Journal, 4(3), 1-7.
- Lodge, M. (1981). Magnitude scaling: Quantitative measurement of opinions. London: Sage.

- Marsh, H. W., Smith, I. D., & Barnes, J. (1985). Multidimensional self-concepts: Relations with sex and academic achievement. Journal of Educational Psychology, 77(5), 581-596.
- Marshall, S.P. (1989). Affect in schema knowledge: Source and impact. In D.B. McLeod & V.M. Adams (Eds.), Affect and mathematical problem solving: A new perspective. (p. 49-58). New York: Springer-Verlag.
- Meyer, M.R. (1989). Gender differences in mathematics. In M.M. Lindquist (Ed.), Results from the fourth mathematics assessment of the national assessment of educational progress. (p. 149-159). Reston, VA: NCTM.
- Meyer, M.R., & Fennema, E. (1992). Girls, boys, and mathematics. In Post, T. R. (Ed.), Teaching mathematics in grades K-8: Research-based methods. (p. 443-464). Ma: Allyn and Bacon.
- Schofield, H. L. (1982). Sex, grade level and the relationship between mathematics attitude and achievement in children. Journal of Educational Research, 75(5), 280-284.
- Schunk, D. H (1989). Self-efficacy and cognitive achievement: Implications for students with learning problems. Journal of Learning Disabilities, 22(1), 14-22.
- Silbert, Carmine & Stein, (1990). Direct Instruction Mathematics. NY: Macmillan.

- SPSS-X User's Guide (3rd. ed.). (1988). Chicago: SPSS Inc.
- Stevens, J. (1992). Applied multivariate statistics for the social sciences. (2nd ed.). NJ:Lawrence Erlbaum Associates.
- Swafford, J.O., & Brown, C.A. (1989). Attitudes. In M.M. Lindquist (Ed.), Results from the fourth mathematics assessment of the national assessment of educational progress. (p. 106-116). Reston, VA: NCTM.
- Tabachnick, B. G., & Fidell, L. S. (1989). Using multivariate statistics. (2nd ed.). NY: Harper and Row.
- Wigfield, A. (1988). Children's attributions for success and failure: Effects of age and attentional focus. Journal of Educational Psychology, 80(1), 76-81.
- Winne, P. H., Woodlands, M. J., & Wong, W. (1982). Comparability of self-concept among learning disabled, normal, and gifted students. Journal of Learning Disabilities, 15(8), 470-475.
- Woolfolk, A. E. (1987). Educational psychology. (3rd. ed.). NJ: Prentice-Hall.

Appendix A (i)



**STUDENT QUESTIONNAIRE**

**PRACTICE SHEET**

a) How much does **Bart Simpson** like listening to the radio?

☐

b) How much do **you** like listening to the radio?

☐

c) How much does **Bart Simpson** like watching T.V.?

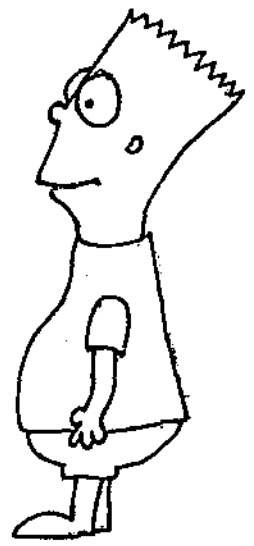
☐

d) How much do **you** like watching T.V.?

☐

Appendix A (ii)

**STUDENT QUESTIONNAIRE  
A**



1. How much does **Bart Simpson** like school?

☐

2. How much do **you** like school?

☐

3. How much does **Bart Simpson** like doing work in class?

☐

4. How much do **you** like doing work in class?

☐

5. How much does **Bart Simpson** like doing worksheets?

☐

6. How much do **you** like doing worksheets?

☐

7. How much does **Bart Simpson** like working in groups?

☐

8. How much do **you** like working in groups?

☐

9. How much does **Bart Simpson** like tests?

☐

10. How much do **you** like tests?

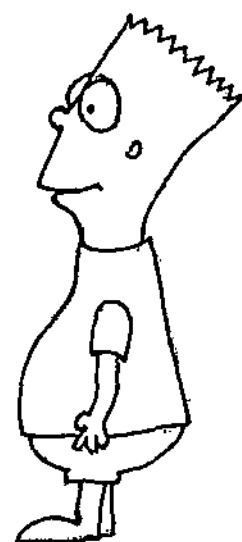
☐

11. How much does **Bart Simpson** like answering questions in class?

☐

12. How much do **you** like answering questions in class?

☐



Appendix A (iii)

**STUDENT QUESTIONNAIRE  
B**

1. How much does **Bart Simpson like** maths?

☐

2. How much do **you like** maths?

☐

3. How much does **Bart Simpson like** working with numbers?

☐

4. How much do **you like** working with numbers?

☐

5. How much does **Bart Simpson like** solving problems in maths?

☐

6. How much do **you like** solving problems in maths?

☐

7. How much does **Bart Simpson like** working with calculators?

☐

8. How much do **you like** working with calculators?

☐

9. How much does **Bart Simpson like** doing tests in maths?

☐

10. How much do **you like** doing tests in maths?

☐

11. How much does **Bart Simpson like** answering questions in class about maths?

☐

12. How much do **you like** answering questions in class about maths?

☐

Appendix A (iv)

**STUDENT QUESTIONNAIRE**

**C**



1. How good is **Bart Simpson** at maths?  
☐
2. How good are you at maths?  
☐
3. How good is **Bart Simpson** at working with numbers?  
☐
4. How good are you at working with numbers?  
☐
5. How good is **Bart Simpson** at solving problems in maths?  
☐
6. How good are you at solving problems in maths?  
☐
7. How good is **Bart Simpson** at working with calculators?  
☐
8. How good are you at working with calculators?  
☐
9. How good is **Bart Simpson** at doing tests in maths?  
☐
10. How good are you at doing tests in maths?  
☐
11. How good is **Bart Simpson** at answering questions in class about maths?  
☐
12. How good are you at answering questions in class about maths?  
☐

## Appendix B

### STUDENT QUESTIONNAIRE INSTRUCTION SHEET

Have you ever seen Bart Simpson on T.V.? I'm sure you all have. He is the boy in the cartoon "The Simpsons" and his picture is at the top of your first page. Now I want you to think about what you know about Bart Simpson and what he is like. Think about how much Bart Simpson likes listening to the radio. If you don't know how much he likes listening to the radio don't worry, I want to know how much you think he likes listening to the radio.

Look at the poster at the front and I will show you what to do. If I think he likes listening to the radio a lot, I draw a long line from the circle (left to right). If I think he doesn't like listening to the radio at all, I draw a short line from the circle. If I think he's somewhere in between, I draw the line as long or as short as I need, to show how much Bart likes listening to the radio but I DON'T GO TO THE EDGE OF THE PAPER.

Now I think about how much I like listening to the radio. I draw a line from the circle (left to right) to show how much I like listening to the radio. If I like listening to the radio more than Bart Simpson, I draw this line longer than the first line I drew.

If I like listening to the radio less than Bart Simpson, I draw this line shorter than the first line I drew. Again, I draw my line as long or as short as I need, to show how much I like listening to the radio compared to how much Bart Simpson likes listening to the radio.

Now look at the next poster. It is your turn to answer the questions.

Question a) How much does Bart Simpson like listening to the radio? Draw the line to show how much you think he likes listening to the radio. REMEMBER: DON'T GO TO THE EDGE OF THE PAPER

Question b) How much do you like listening to the radio? Draw the line to show how much you like listening to the radio compared to how much Bart Simpson likes listening to the radio.

Next, think about how much Bart Simpson likes watching T.V. and draw the line.

Then think about how much you like watching T.V. and draw the line.

Now turn to the next page:-QUESTIONNAIRE A  
I will read the questions out loud. Do not answer a question until I have read it. Think about how much Bart Simpson likes school. Do you think he likes going to class every day? Draw the line to tell me how much you think Bart Simpson likes school. Now think about how much you like school.

If you like school more than Bart Simpson, draw a line longer than the first line you drew. If you like school less than Bart Simpson, draw a line shorter than the first line you drew.

Remember:-DON'T GO TO THE EDGE OF THE PAPER!

Turn the page to QUESTIONNAIRE B

Think about how much Bart Simpson likes maths. Do you think he likes doing maths in class? Draw the line to tell me how much you think Bart Simpson likes maths. Now think about how much you like maths. If you like maths more than Bart Simpson, draw a line longer than the first line you drew. If you like maths less than Bart Simpson, draw a line shorter than the first line you drew. Remember:-DON'T GO TO THE EDGE OF THE PAPER!

Turn the page to QUESTIONNAIRE C

Think about how good Bart Simpson is at maths. Do you think he gets a lot of sums right in maths? Draw the line to tell me how good you think Bart Simpson is at maths. Now think about how good you are at maths. If you are better at maths than Bart Simpson, draw a line longer than the first line you drew. If you are not as good at maths as Bart Simpson, draw a line shorter than the first line you drew. Remember:-DON'T GO TO THE EDGE OF THE PAPER!