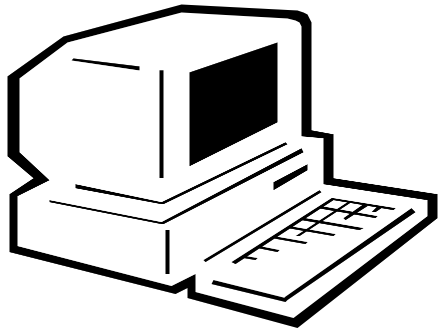


Computers in Education: Barbadian Children's Attitudes and Perceptions of Mathematical Applicability

Coreen J. Leacock
Trinity Hall

Thesis submitted as part of the requirements of the degree of Master of Philosophy in Education

Faculty of Education
University of Cambridge

July 2000

TABLE OF CONTENTS

	Page
Abstract	I
Declaration	II
Acknowledgments	III
List of Tables	IV
List of Figures	V
CHAPTER ONE: RATIONALE FOR THE RESEARCH	
Introduction	1
Conceptual Framework	3
Rationale for the Research Questions	3
CHAPTER TWO: REVIEW OF LITERATURE	
Introduction	6
Computer in Education	6
Computers In Mathematics Education	7
Attitude and Attitude Measures	10
Students' Computer Attitudes by Gender	13
Students' Computer Attitudes by Age	16
Students' Computer Attitudes by Experience	18
Perceptions of Use of Computers in Classrooms	20
Conclusion	22
CHAPTER THREE: RESEARCH STRATEGY & DESIGN	
Introduction	24
Assumptions of the Research	25
Ethical Concerns	26
The Schools	27
The Participants	28
Instruments	30
The Questionnaire	31
Piloting the Attitude Scale	33
The Written Paragraph	34
The Interview Schedule	34
Procedure	35
Data Collection	36
Compiling the Data	38
The Questionnaire	38
The Written Paragraph	39
The Interviews	39

Analysis Of Data …… 39

CHAPTER FOUR: RESULTS & DISCUSSION

Results …… 42
Computer Access …… 42
Access to Computers by Gender …… 43
Access to Computers by Form (Age) …… 43
Computer Use …… 44
Computer Use by Gender …… 44
Computer Use by Form (Age) …… 45
Factor Analysis …… 47
The Students' Attitudes Toward Computers …… 50
Gender and Computer Attitudes …… 51
Age and Computer Attitudes …… 52
Computer Experience and Computer Attitudes …… 56
Students Perceptions of the Usefulness of Computers in Mathematics Classes …… 59

CHAPTER FIVE: CONCLUSION

Summary …… 64
Implications for Further Research …… 69

REFERENCES …… 71

APPENDICES

Appendix 1:The Statements on the Computer Attitude Scale (Loyd & Gressard, 1984) … 78
Appendix 2: Questionnaire Used for Data Collection in the Study …… 79
Appendix 3: The Topic for the Paragraph …… 81
Appendix 4: The Cover Letter that was Read to the Participants of the Study …… 82
Appendix 5: The Interview Schedule that was Piloted …… 83

ABSTRACT

The purpose of this study was to explore the attitudes that Barbadian secondary school students hold toward computers and their perceptions of the usefulness of computers in mathematics classes. The Loyd and Gressard Computer Attitude Scale was administered to 364 students in the first and fourth forms of two secondary schools, along with a questionnaire that gather information about the students' gender, age group and experience with computers. In addition, the students were asked to write a paragraph saying whether or not they felt computers would be useful in mathematics classes and why.

An analysis of the computer experience was carried out by age and gender in light of the findings of other research studies that computer attitudes might be closely linked to computer experience, and that differences in attitudes might be a reflection of differences in experience. Gender differences were found only for access to computers in secondary school, and frequency with which the computer was used to surf the Internet. Age related differences were found for access to computers in primary school and in secondary school, as well as for the frequency with which games were played.

A principal components factor analysis was carried on the 30 items on the attitude scale and four dimensions emerged: Fear/Anxiety, Enthusiasm, Persistence and Indifference. These were used in the analysis of the data from the attitude scale. The results of these analyses suggested that students in the sample generally held positive attitudes toward computers. No gender differences were indicated, but younger students were found to experience higher levels of anxiety than did older students. No differences in attitudes were found between students with home access to computers and those without. Also, students who often used computers to surf the Internet were found to be more enthusiastic about computers then those who did not.

The students written paragraphs revealed that most of them felt that computers would be very helpful in mathematics classes. The cited exciting lessons and individual work as some of the benefits. Some students had less positive feelings about computers in their mathematics classes. Encouragement of mental laziness was one disadvantage mentioned. These negative views were expressed by students who had low as well as high scores on the attitude scale.

DECLARATION

I, Coreen J. Leacock, hereby declare that this thesis was planned, researched and composed by me, that it is my own work and that any work by any other author is cited through references in the text and in the list of references.

I also declare that this work is not substantially the same as any other previous work that I have submitted for any other degree or qualifications.

The length of this thesis (excluding tables, figures, the list of references and appendices) is ________________ words.

University of Cambridge

July 2000

ACKNOWLEDGEMENTS

I wish to extend my sincerest to all who contributed in any way to the production of this thesis. I wish however to express special thanks to the following persons:

Dr. Paul Andrews, who endured my many bouts of insecurity, while providing splendid advice and guidance, and all this with great humour;

S. J. Warrican, my study buddy, who suffered when I was frustrated with my work, provided moral support, read countless drafts and still proofread the final copy of this thesis; and

My family in Barbados, who provided moral support through regular telephone calls numerous e-mail messages, and the occasional bottle of rum.

Coreen J. Leacock

LIST OF TABLES

Page

Table 3-1: The Numbers of Students in the Research Sample, Shown by School, Gender and Year Group ………………………………………………...……………….... 29

Table 4–1: Students' Access to Computers by Gender and Form (Age)………….....……………… 42

Table 4–2: Students' Use of the Computer by Gender ……………………………………………. 44

Table 4–3: Students' Use of the Computer by Form (Age) ……………………………………….. 45

Table 4–4: Correlation Coefficients for the Original Three Subscales and the Four New Subscales ………………………………………………………………………… 49

Table 4-5: The Means and Standard Deviations of the Modified Attitude Scale and the Four Subscales ………………………………………………………………………… 50

Table 4-6: The Results of Mann-Whitney Tests on the Scores for Girls and Boys on the Four Components of the Attitude Scale and the Whole Scale …………………………… 51

Table 4–7: The Results of Mann-Whitney Tests on the Scores for Form 1 and Form 4 on the Four Components of the Attitude Scale and the Whole Scale …………………………….. 52

Table 4-8: The Results of Mann-Whitney Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Places of Computer Access …………. 54

Table 4-9: The Results of Kruskal-Wallis Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Social Conditions of Use ……………. 54

Table 4-10: The Results of Kruskal-Wallis Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Frequency with which They used the Computer for Given Activities ……………………………………………………….. 55

LIST OF FIGURES

Page

Figure 1-1: Conceptual Framework ………………………………………………….. 88

Figure 4-1: Details of the Factor Analysis Showing the Loadings on Each Item … ………………………………………………………... 99

CHAPTER ONE

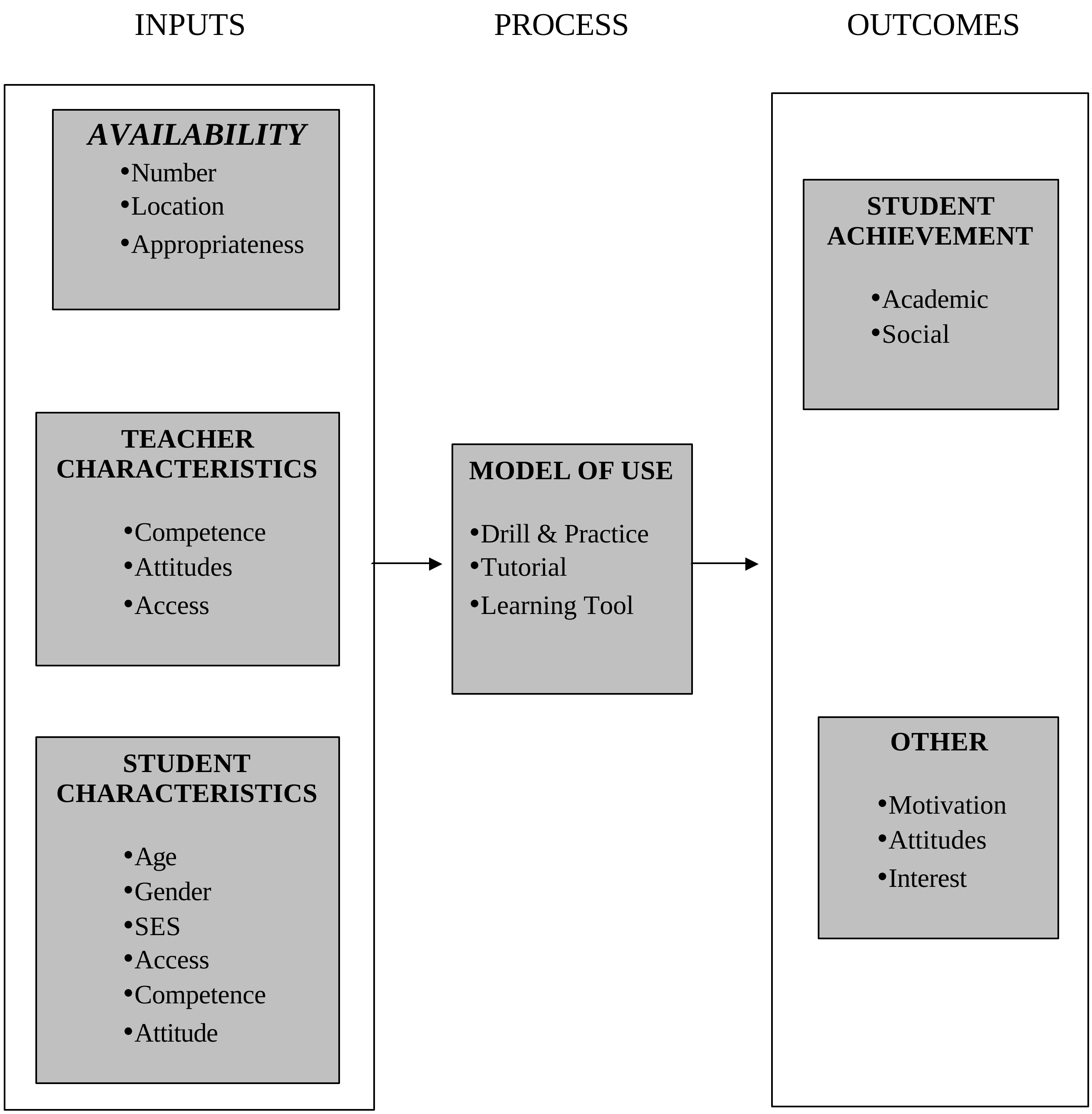
RATIONALE FOR THE RESEARCH

INTRODUCTION

Barbados is a small, rapidly developing island state in the Caribbean. In the last ten years, concern has been expressed about low levels of achievement of students in the schools. In addition, employers complain that school-leavers do not possess the kinds of skills needed in today's technological age, where the ability to handle information and to communicate is vital. Students are leaving school with poor academic qualifications, few marketable skills, poor problem-solving abilities and a general disaffection with society (Ministry of Education, 1995). Reform of the education system was suggested, with the integration of computers into all subject areas at all levels of instruction as a major innovation. The anticipated outcomes included improved literacy and numeracy skills, enhanced verbal, mathematical and visual learning, development of higher order thinking skills, enhanced learning motivation, self-esteem, as well as inter-personal and social skills (Ministry of Education, 1997).

Like many nations, computers have been in Barbadian schools in varying numbers from the late 1980s. As elsewhere, the computers were used mostly for activities like programming, word-processing and as an occasional reward for a few students. Thus, a more complete integration of computers into the curriculum is an innovation in the Barbadian context. The experiences of other countries have indicated that certain factors have a profound impact on the outcomes of this innovation. These include availability of and access to computers and appropriate software; characteristics and competencies of teachers and students characteristics. However, the present researcher was unable to find any research undertaken in a setting like Barbados – a small developing country with limited resources. Thus, a study of the initial impact of the introduction of computers into the schools' curricula

Figure 1-1: CONCEPTUAL FRAMEWORK



in Barbados would not only provide valuable information for its educational community, but also add to the body of knowledge about the use of computers in education in different countries around the world.

CONCEPTUAL FRAMEWORK

The present study considers an aspect of the wider impact of computers on education in Barbados. Studies of the impact of computers on education have identified three major areas of interest – inputs (influential factors), the processes (what is done) and the outcomes (the resulting factors) (Pelgrum & Plomp, 1991). Miles and Huberman (1994) suggested that one means of situating a research project is to conceptualize a framework that shows the relationship between variables to be studied. Figure 1–1 below illustrates the inputs, processes and outcomes that the researcher believes would be of interest to study in order to gain some insight into the impact of computers on education.

RATIONALE FOR THE RESEARCH QUESTIONS

Since the time available for this study was limited, a decision was made to concentrate on one area. As the integration is in its infant stages, it was considered prudent to focus on the inputs of the innovation. Consideration of all three input components would not have been practical, and hence a decision was made to limit this study to the students' characteristics, namely students' attitudes toward computers. This seemed reasonable since there is no research-based evidence concerning Barbadian student's attitudes toward computers.

In Barbados, there is a general sense that students are enthralled by computers and eager to use them in their classroom activities. This conflicts with research suggesting that some students may have "low computer motivation" and may avoid using computers, may find them restricting, and may think that they promote mental laziness (Galbraith & Haines, 1998). In addition, Brosnan (1998) pointed out that children are becoming increasingly computer anxious at an earlier age. These findings weigh against what Maddux (1988) called the myth that wonderful things happen whenever children and computers are placed in the same room. Thus, questions about the true state of Barbadian students' attitudes toward computers were raised. These questions were deemed important because research suggests that students' use the computers and their attitudes toward computers are linked (Sutton, 1991). Further, it seems possible that the manner in which computers are used in the classroom could affect the educational outcomes.

An examination of research (e.g. Loyd & Gressard, 1984a; Nelson, 1988; Kirkman, 1993; Kinnear, 1995; Kirkpatrick & Cuban, 1998; Brosnan, 1998) revealed that students with different characteristics may hold different attitudes toward computers. Indications are that the gender, age, computer access/experience and socioeconomic status (SES) of the student may be associated with differential computer attitudes. A decision was made to ascertain whether such trends also exist among Barbadian students. However, since a straightforward and inoffensive method of assessing SES in the Barbadian setting was not readily available, this characteristic was omitted. Thus, the selected research questions were centred round not just the students' attitudes toward computers, but also the relationship between individual characteristics and these attitudes.

Another assumption made in the Barbadian context is that the use of computers will contribute to a rise in students' academic achievement. This is thought to be especially true for mathematics, a subject often considered difficult by students. Indeed, the usefulness of computers in learning mathematics was powerfully made by Papert (1993) who asserted that they provide students, even the very young, with an environment in which to explore mathematical ideas and develop mathematical skills and understandings.

However a question raised was whether or not Barbadian students think that computers can help them to learn. Thus it was decided to investigate students' feelings prior to their regular use of computers in their mathematics lessons. In the follow-up research, after students have been using computers, any changes in students' perceptions of the usefulness of computers in mathematics can be assessed to ascertain the impact of experience with computers in this area.

With these consideration then, the following research questions were formulated.

- What attitudes do Barbadian students have toward computers?
- Are there gender differences in attitudes toward computers?
- Are there age-related differences in computer attitudes?
- Do students with different kinds of computer experiences have different attitudes toward computers?
- What are students' perceptions about the usefulness of computers in their mathematics classes?

This study is aimed at gaining some insights into the attitudes of Barbadian students toward computers. The answers to the above questions are considered to be valuable because they provide information about a factor that can have some effect on the impact of the integration of computers in education in Barbados.

CHAPTER TWO

REVIEW OF LITERATURE

INTRODUCTION

In this chapter, literature pertaining to the use of computers in education, especially mathematics education is briefly discussed. Since the concept of attitudes is central, literature on attitudes and attitude measures is considered. This is followed by a review of literature on children's attitudes toward computers in general and toward the use of computers in mathematics. The research findings are discussed in light of the context of the research being undertaken here.

COMPUTERS IN EDUCATION

The closing years of the twentieth century saw the introduction of computer technology into almost all spheres of human endeavour – industry, travel, commerce, communication and medicine, to name a few. It is therefore not surprising that computers have found their way into classrooms as well. Many countries in the "developed world" have had computers integrated into their education systems for several years and many developing countries like Barbados are following suit rapidly. Much has been written about how computers are changing the education environment (e.g. Thompson, 1991, Welle-Strand, 1999), factors affecting the use of computers in schools (e.g. Zammit, 1992; Pelgrum & Plomp, 1993), how computers are being used in different subject areas (e.g. Becker, 1984; National Council for Educational Technology (NCET), 1996) and how students' achievement in and attitudes to schoolwork are being affected (Johnston, 1987; Hativa, 1988; Kinnear, 1995).

For almost three decades, computers have been used in classrooms around the world. Some persons have hailed them as having the potential to revolutionize learning in dramatic ways (Papert, 1980) while others have urged caution (Becker, 1984, Postman, 1995, Baines, 1997). Despite the debates about their value in education, computers continue to be used in different ways in classrooms worldwide. For example, computers are used as machines to be programmed to help solve problems (Ball, 1987a, 1987b), for drill and practice (Hativa, 1988; Moore, 1993), as well as an object *about* which students learn in information technology classes (Van Weering & Plomp, 1991). More and more in recent years, the computer has been touted as a "cognitive tool" (Reeves, 1998) *with* which children can learn. This has been met with greater efforts to integrate computers into all curriculum areas (e.g. see North, 1991). One curriculum area that has long been associated with computers and computer instruction is mathematics.

COMPUTERS IN MATHEMATICS EDUCATION

The association between computers and mathematics has been very strong. For example, in Britain in the 1960s, computer science was taught by mathematics teachers and the emphasis was placed on programming and numerical operations (Tanner, 1992). However as the technology advanced, diverse uses for computers in mathematics were found.

Howe and Du Boulay (1979) identified several types of computer software that are applicable in mathematics. These include drill and practice, for tutorials, for simulations, modeling, and general application programs. Brownell (1992) also identified similar categories (or modes of use). Brownell proposed three modes of use for the computer: the computer as a tutor (e.g. drill & practice, tutorials, simulations, instructional games), as a tool (e.g. statistical packages, spreadsheets, databases), and as a tutee (e.g. LOGO, BASIC). In addition, some software may be subject specific, and designed to present specific mathematics concepts while other software, like spreadsheets, are general tools put to a mathematical use. Documented evidence of the different uses of computers in mathematics classes suggests differential outcomes.

Drill and practice software has been used to reinforce concepts that students are learning in their classes. With these types of activities, questions are generated by the software and the students are required to type the answer. Feedback about the correctness of the answer is given.

In some cases, hints and clues are offered to help the student who supplies incorrect responses. Research into the use of drill and practice computer software suggests that, although these activities can be useful to some students, others student learn very little from them. For example, Mevarech, Shir and Movshovitz-Hadar (1992) reported that a group of fifth-grade Isreali students who used drill and practice software for geometry concepts scored higher on achievement tests than their counterparts who practiced on worksheets from their textbook. However, Hativa (1988) and Moore (1993) showed that some students, for example low achieving students or students who do not have an adequate grasp of fundamental concepts, may in fact benefit very little from drill and practice computer activities.

According to Brownell (1992), the aim of *tutorial* software is to instruct students by engaging them in a dialogue related to the concept, skill or information being taught. As the students interact with the software, the program branches to material to suit their needs. Thus unmastered concepts may be re-presented with necessary instructions. A limitation of such software is that it restricts students' responses in order to control the number of branches available. On the other hand, one advantage cited by Brownell is that the computer is a patient teacher that allows the students to move at their own pace without embarrassment.

Today, tutorial programs are often presented as integrated learning systems (ILS). Although research studies (West, 1998; NCET, 1996; MacNab & Fitzsimmons, 1999) report positive results when ILSs are used for mathematics instruction, some cautions are indicated. For example, the NCET reported that able students who used a particular ILS program were irritated by the fixed learning style it presented and the fact that it did not recognize alternative problem-solving strategies. Also, West, referring to the same ILS program, warned that although some positive results were possible, it was not a teaching tool in its own right and that the services of a well-qualified mathematics teacher were essential.

One content-free software application that is a powerful tool in mathematics is the *spreadsheet*. A spreadsheet is a grid with rows and columns into which data may be entered. The students can determine which data to enter in the cells of the spreadsheet and can define operations to be carried out using this data with relative ease. An advantage of the spreadsheet is that whenever a value is entered or changed, all other related cell values are automatically updated. Thus, spreadsheets can reduce time spent on tedious, error-prone calculations as well as time-consuming graphical representations. Three levels of spreadsheet use are recommended:

i. students use spreadsheets prepared by the teacher;

ii. students prepare a spreadsheet based on the teacher's design; and

iii. students design their own spreadsheets to model problems.

LOGO is a much-researched programming language designed by Seymour Papert to help children to develop problem-solving skills (Papert, 1980). It is touted for its feature of providing the learner, especially very young children, with an environment in which to explore powerful mathematical ideas using "turtle geometry". Research (Mevarech & Kramarski, 1993; Mevarech & Kapa, 1996) has shown that children can benefit both cognitively and socially when working with LOGO. In addition Subhi (1999) suggested that it is possible for children working in a LOGO environment to draw on mathematics concepts of operations, place value, estimation, length, angles, standard units of measure, symmetry and proportion.

Investigations (Hativa, 1988; Mevarech, Shir & Movshovitz-Hadar, 1992, Moore, 1993; Subhi, 1999) into the effects of different computer software on learning have yielded differential results, some positive and others less so. This may be an indication that different types of software may be suitable for learners with different characteristics. However, whatever the cognitive benefits, some suggest (e.g. Kosakowski, 1998) that the motivational qualities of computers in mathematics are extremely valuable. Mathematics is often considered a difficult subject to learn and after experiencing failure, many students become disenchanted. But according to Kosakowski, there is evidence to suggest that students who use computers for computer assisted instruction (CAI) in school feel more successful and hence are motivated to learn. This, he pointed out, was true across a variety of subject areas, and especially among students in special education, inner city and rural schools.

The touted motivational characteristics of computers may lead some to the conclusion that all students are enthusiastic about computers and will readily embrace them as learning tools. However, Galbraith and Haines (1998) wrote of students with low computer motivation, who may avoid using computers, or even if they are forced to use them, may experience great anxiety (Brosnan, 1998). This possibility has implications for the use of computers in educational settings. If students have negative feelings about computers, having to use them as learning tools could impede learning. In fact, Hannaford (1988) suggested that whether or not computers are effectively used in classrooms may be dependent on the attitudes that teachers and students hold toward them. The remainder of this review is focused on research about attitudes, attitudes towards computers and attitudes toward the use of computers in mathematics classrooms.

ATTITUDE AND ATTITUDE MEASURES

The concept of attitude is somewhat controversial. One major difficulty relates to its definition. Allport (1935) listed at least sixteen different definitions that were given for attitude in the early1900s. He concluded that attempting to propose a single definition would exaggerate the degree of consensus on the matter. That situation continues to exist today, since there is not a single definition that is accepted universally. Despite the differences in definitions, Allport (1935) showed that the common thread running through them is the notion of attitude as a "preparation or readiness for response" (p. 8). He also suggested that attitude is not behaviour, but a precondition of behaviour, and that it may exist in all degrees of readiness, from dormant traces of forgotten habits to the tension or motion which is actively determining a course of conduct that is under way.

Some definitions suggest that attitude is unidimensional, relating only to affective or evaluative reactions, while others portray it as multidimensional, relating to the cognitive, affective and behavioural domains (Ajzen & Fishbein, 1980). The debate about the nature of attitude continued into the 1980s (Bagozzi & Burnkrant, 1979, 1985; Brecker, 1984, Dillon & Kumar, 1985), but Ajzen and Fishbein (1980) reported that the multidimensional view of attitude was adopted *almost* universally in the middle of the 1950s. They therefore stated that generally, attitude is considered a complex system comprising persons' beliefs about an object (cognition), their feelings toward that object (affection) and their inclinations, intentions and action tendencies with respect to the object (conation or behavioural).

Attitude is a construct and it cannot be directly observed, but it is seen to be manifest in responses that are observable and measurable. Attitude can be inferred from responses related to the three categories mentioned before, and according to Ajzen (1988), each category can be separated into two modes: verbal and non-verbal. Verbal cognitive responses are manifest in expressions of beliefs about an object, however, Ajzen suggested that non-verbal cognitive responses must be assessed more indirectly. No indication as to what such indirect assessment might entail. Affective verbal responses are evident in expressions of feelings toward an object, while non-verbal responses can be seen in facial expressions and other physiological reactions. Verbal conative or behavioural responses can be in the form of expressions of intended actions under given circumstances, while non-verbal responses are manifest in what individuals do. In each case, responses may be positive or negative.

There is some disagreement over the relationship between attitude and the three components (Bagozzi & Burnkrant, 1979, 1985; Brecker, 1984, Dillon & Kumar, 1985). Indeed, Fishbein (1967) suggested that rather than being viewed as parts of attitude, cognition and conation should be treated as independent phenomena that are related to, and serve as indicants of, an individual's attitudes. However, for this study, the multidimensional view of attitude will be embraced, and Ajzen's (1988) definition of attitude will be adopted. According to Ajzen, "an attitude is a disposition to respond favorably or unfavorably to an object, a person, institution, or events" (p. 4). This definition seems to take into account Allport's (1935) admonition that attitude is *not* behaviour, but merely a precondition of behaviour or a disposition to behave in a particular way.

According to the tenth edition of the *Concise Oxford Dictionary*, a disposition is "a person's inherent qualities of mind and character, an inclination or tendency". Thus, Ajzen's definition suggests that attitude is a *tendency* or *inclination* to respond to an object in a particular way. Of course, this does not mean that an individual *will* respond in harmony with the possessed attitude, since as Fishbein (1967) suggested, behaviour toward an object may be a function of many variables – for example situational and individual difference variables – of which attitude toward the object is only one. An assumption of this study therefore, is that attitude is worth investigating, since although it may not be the sole determinant of how an individual behaves toward an object, it can be an important contributing factor.

As mentioned before, attitude is a construct and cannot be directly assessed. It must therefore be inferred from verbal and non-verbal expressions. Among the methods devised to assess attitude are self-report scales such as Thurstone scales, Guttman scales, semantic differential scales, and Likert scales (Fishbein, 1967; Robson, 1993) and direct observation techniques (Robson, 1993). The most frequently used of these are the semantic differential and Likert scales (Robson, 1993; Gay, 1996). A semantic differential scale is a collection of bipolar adjectives such as good – bad, which may apply to the attitude object. These pairs of adjectives are arranged on a continuum with usually five or seven intervals. Each interval is assigned a score, say from 1 to 5 or 1 to 7. For each respondent, the mean of the ratings for the pair of adjectives is computed.

A Likert-type scale comprises a collection of positive and negative statements about the attitude object, to which the respondent indicates his/her degree of agreement on a five or seven point scale. For example, responses may range from strongly agree to strongly disagree, with positive statements scored from 1 for strongly disagree to 5 for strongly agree and negative statements scored in reverse order. Again, the respondent's scores are computed by finding the mean on all the items. Both the semantic differential and the Likert-type scales suffer from the difficulties of self-report measures. For example, respondents may consciously or unconsciously respond in a socially acceptable manner, which may render the results meaningless (Gay, 1996).

The existence of a variety of definitions of attitude and the different types of attitude measures is reflected in the area of computer attitudes. For example, attitudes toward computers have been assessed by means of semantic differential scales (Harvey & Wilson, 1985; Hannaford, 1988; Nelson, 1988) and Likert-type scales (Reece & Gable, 1982; Loyd & Gressard, 1984a; Woodrow, 1991), with instruments which, according to Woodrow (1991), address various combinations of the three components of attitude, and at least twelve different dimensions, including enjoyment, anxiety, efficacy, confidence, and usefulness. The remainder of this chapter is a review of some of these studies conducted among school students. The findings of these studies as they relate to gender, age and computer access and experience will be emphasized.

STUDENTS' COMPUTER ATTITUDES BY GENDER

There is a general sense that differences in computer attitudes exist between the genders. To some (e.g. Sutton, 1991; Kirkpatrick & Cuban, 1998) this is cause for concern because as computers become more prominent in our lives, persons with negative attitudes would be at a serious disadvantage. Research has suggested that social factors may be contributing to the development of differential gender-related attitudes toward computers. For example, Hess and Miura (1985) found that parents were more likely to support boys in computer camps than they would girls. Ware and Stuck (1985) showed that in computer magazines, males were more likely than females to be portrayed as active computer users, and Huff and Cooper (1987) reported that computer software was designed to appeal to boys more than girls. Over the years, several studies have therefore been undertaken to identify gender differences in computer attitudes. The findings of some of these studies are examined below.

Harvey and Wilson (1985) reported a study conducted among 193 students (95 from two primary schools and 98 from two secondary schools) in the 10 – 12 age group in England. A 20-item semantic differential scale was administered to the students (85 girls and 108 boys) to assess their attitudes toward computers. The students were also asked to write a short essay stating what they thought about microcomputers. Significant gender differences were found on only three of the items which were analyzed separately. Boys were found to be more likely to see the computer as "fun" and "smarter", whereas girls found them to be more "expensive". In addition, the essays indicated that girls and boys were equally enthusiastic about computers. Harvey and Wilson concluded that there was very little gender difference in attitudes toward computers.

An interesting finding of this study is the fact that, although boys and girls expressed equal enthusiasm about computers, twice as many boys as girls owned a home computer. Harvey and Wilson speculated that it was likely that parents were more inclined to buy computers for sons than for daughters. The researchers also speculated about the role of parental attitudes toward computers and how these might have eventually influenced the young girls in this study. In fact, in those early years when microcomputers were relatively new, other researchers were concerned about the influence of socialization on the development of differential gender attitudes toward computers.

For example, Hess and Miura (1985) examined student enrollment in computer camps and classes and found that parents were more likely to enroll their sons than they would their daughters. In addition, Ware and Stuck (1985) investigated the portrayal of computer users in computer magazines and found that females were less likely to be presented as active users of computers than were males. These findings seem to support the speculation of Harvey and Wilson (1985) that girls and boys were being socialized to have different attitudes toward computers.

Nelson (1988) used a similar instrument in a study conducted among a sample of students in Western Australia. He however corrected what could be considered as a flaw in the Harvey and Wilson instrument. Harvey and Wilson’s scale had all the perceived positive adjectives on the left side. This increased the chances that, had any students become stuck in a response set and placed a mark in a similar position for all the items, the results could have been affected. No doubt, to avoid or lessen this possibility, Nelson rearranged some of the items so that some pairs had the positive adjective first and some had the negative adjective first.

Like Harvey and Wilson, Nelson used a convenient sample of primary and secondary school students. However, the age range was wider. The Australian sample consisted of 105 boys and 96 girls in the 5 – 15 age group. Although no tests of significance were done due to the non-random selection of the sample, trends in the data suggested that overall, boys were more positive about computers than girls. In this study, girls were more likely than boys to view the computer as being simple, slow, lazy and unimaginative. Despite these differences and the fact that more boys than girls owned a computer, it seems that overall, the gender differences were not significant.

It is worth noting here that the analysis of the data from these two studies could call into question the usefulness of semantic differential scales for assessing computer attitudes. Or perhaps the question should be about the adjectives included on the scales. For example, knowing that girls were more likely than boys to consider the computer to be expensive does not really tell about their attitudes toward computers. Perhaps the data may have provided better information about the attitudes of the students in the sample if the factor analytic approach suggested by Ransley (1991) were applied. Ransley ran a principal component factor analysis on the items on a semantic differential scale and identified five dimensions. He suggested that these dimensions could be used to study differences in attitudes toward computers. Thus, instead of discussing the data in terms of individual items, the researcher could refer to dimensions of attitude as suggested by the responses on *groups* of items. This seems to be a more useful approach to analyzing data from semantic differential scales.

Another widely used data-collecting tool in attitude research is the Likert-type scale. Loyd and Gressard (1984a, 1984b) developed and used a Likert-type scale to assess computer attitudes. The instrument provided scores on three subscales designed to measure computer anxiety, computer confidence and computer liking. Each subscale consisted of ten statements to which respondents had to select one of four responses ranging from "agree" to "disagree". The instrument was administered to 354students attending high school, a community college and a liberal arts college in the United States. The sample included 137 males and 217 females. The three-factor analyses of variance that were carried out on the scores for the three subscales indicated no significant main effects for gender.

Some years later, Kirkman (1993) obtained different results in the UK. In that study, a survey of computer attitudes was carried out among 199 twelve-year old students in a comprehensive school. Data were collected from the 102 girls and 97 boys using a five-point Likert-type attitude scale and interviews. Two tailed *t*-tests carried out on the data indicated that compared to girls, boys were more enthusiastic and more confident, they spent more time on home computers and considered themselves better at using computers. A similar finding was made by Okebukola and Woda (1993) who administered a computer interest scale and a computer anxiety scale to 139 girls and 142 boys in Year 11 in a number of high schools in Western Australia. They reported that girls scored significantly highly on the anxiety measure and significantly lower on the interest scale.

There may be several reasons for the differences in results reported in these studies. One such reason could be related to the setting of the research, for example, the country. However, differences in methodology may also have been a contributing factor. Different instruments were used, different age groups were involved and different approaches to data analysis followed. All these factors may have had some bearing on the findings. Of course, another reason could be that such differences actually exist. If this is so, the question could be asked about factors that may facilitate or encourage these differences among some students and not among others.

A very plausible explanation could be differences in socialization. Harvey and Wilson (1985) speculated that the lack of significant gender-related differences in attitudes toward computers could have been attributed to the fact that microcomputers were fairly new and that the girls had not yet been affected by societal attitudes. It is now quite possible that girls in certain environments could be influenced by differential socialization practices such as those suggested by Hess and Miura (1985). This view is shared by Sutton (1991) who argued that home and school practices were major contributors to the gender inequalities in access to computers, which in turn may contribute to differential gender-related attitudes.

STUDENTS' COMPUTER ATTITUDES BY AGE

According to Brosnan (1998), as computers become more widely used in the lower grades at schools, students are being affected by computer anxiety at earlier ages. Harvey & Wilson (1985) examined age-related computer attitudes among the sample in their study by comparing the responses that the students in primary and secondary schools gave on the semantic differential scale. They found that there were no significant differences between these two groups of children on the greater number of items on the scale. However, they found that the younger children thought that the computer was more "friendly", "understandable", "newer" and "bigger" than did the secondary school group. Nelson (1988) found that for his Australian sample, students in the 5 – 10 age group considered computers to be more "hardworking", "understandable", "friendly" and "colourful" than did the 11 – 15 year – olds.

It is possible that the type of activities that these students used the computer for played a major role in the formation of their attitudes. For example, Wilder, Mackie and Cooper (1985) found that younger children used computers mainly for playing games or for educational drill and practice activities that may be game-like. Older students were more likely to be receiving formal instruction with computers and this may have some effects on their attitudes.

In the Loyd and Gressard (1984a) study, the sample was arranged into four age groups, 13 – 15, 16 – 18, 19 – 20 and over 21. The results of the analyses of variance carried out on the data from the three subscales of the computer attitude scale indicated that there were no main effects for age on any of the subscales, although there were significant age and experience interactions for computer confidence and computer liking. They identified three levels of computer experience: little, some and substantial experience.

On the Confidence subscale, for those with substantial experience, there were no significant differences among the age groups. However, among those with little experience, those 21 years and over were more confident than the 16 – 18 year olds, while among those with some experience, they were more confident than the 13 – 15 year olds. Although no clear trends seemed to be present among the age groups with different levels of experience, there was a suggestion that perhaps as students moved through the education system and gained experience with computers, their confidence increased. On the Liking subscale, among those with little and substantial experience, where significant differences were found, these were in favour of the 13 – 15 year olds. Loyd and Gressard's conjecture that this might be a reflection of younger students associating computers with games seems reasonable, as other studies have shown this to be the case.

Other investigations into age-related attitudes toward computers were conducted by Barba (1991) who administered a "draw–a–computer user" test to students from kindergarten to grade five. Based on their depictions, Barba concluded that the students associated happiness with computer users, and that the older children tended to associate the use of the computer with everyday use in diverse job settings. This was in contrast with adults, who tended to think of computer users as "white-haired, bespectacled, absent-minded professors" (p. 735), or as a "mad scientist or crazy inventor" (p. 734). It may be the case then, that as computers become part of the everyday lives of students, they could accept them more and more as a part of their world, and age-related attitudes to computers could eventually disappear.

STUDENTS' COMPUTER ATTITUDES BY EXPERIENCE

Sutton (1991) lamented the perceived inequity of access to computers. She suggested that access to computers and consequent computer experience were factors that seemed to influence students' attitudes toward computers. Experience here refers to the access that the students had to computers, as well as the uses to which they put them.

Several of the studies examined (Loyd & Gressard, 1984a; Harvey & Wilson, 1985; Martin, 1991; Kirkman, 1993) suggested that students with high access to computers tended to have more positive attitudes than those with restricted or no access. Harvey and Wilson (1985) found that students who owned computers were more favourably disposed toward computers than those students who did not own one. They also tended to be more impressed by the capabilities of computers and found them easier to use.

Martin (1991) reported research in which the computer attitudes of 328 fourteen- and fifteen-year-old students in an English comprehensive school were assessed. This study revealed that students with home access, even students who had previously had high access to computers, displayed more positive attitudes than those who had not, and reported less negative reactions to working with computers. In addition, Kirkman's (1993) study revealed that in his sample, the students who had access to computers at home were significantly more enthusiastic toward computers, considered themselves good at using computers, were more confident, and perceived computers as more useful than children who had no home access. They also spent more time on computers in their schools.

Loyd and Gressard (1984a) measured computer experience in terms of the length of time that the participants had used computers. They found a main effect for computer experience on the three subscales of their instrument. In each case, participants who reported most experience held the more positive attitudes. These researchers raised an interesting question about the relationship between experience and attitudes. They questioned whether computer experience led to positive attitudes or whether positive computer attitudes caused the students to seek opportunities to for more experience. While this current study did not set out to seek an answer to this question, it is one that could be investigated at a later date.

It is interesting to note that not all the studies examined found positive attitudes linked to computer access. Kinnear (1995) reported a study that monitored the computer attitudes and the perceptions of the use of computers of two classes of primary school students over a period of nine months. Access was possible during formal teaching periods, during recess and lunch breaks. Twenty-five students completed a Likert-type questionnaire that assessed their attitudes on five subscales relating to computers – usefulness in classrooms, usefulness in jobs, sexism and ability, uneasiness about computers as well as cleverness and computer ability. The instrument was administered prior to and following access to the computers at their school. One of Kinnear's findings was that after the nine-month period, there was a deterioration of attitudes about the usefulness of computers on the part of the girls.

Kinnear reported that boys were more aggressive in claiming time on the computer. One might be tempted to believe that this might have limited the girls' access to the computers and therefore could have had an effect on their attitudes. While this was possible, Kinnear pointed out that even when arrangements were made so that girls could have greater access to the computers, after the novelty had worn off, the girls tended to choose to spend their break times in "more traditional socializing activities" (p. 38) instead of on the computer. This seems to suggest that greater access to the computers might not have had the expected positive effect on these girls' attitudes toward the computers.

Generally though, research seems to suggest that students who have access to computers and who use them regularly are more positive than those who do not. In addition to the studies examined here, Brosnan (1998) indicated that, especially for females, computer experience was linked with positive computer attitudes.

PERCEPTIONS OF USE OF COMPUTERS IN CLASSROOMS

The fact that computers are often associated with games could cause students to doubt their ability to be used in "serious" work. Researchers have therefore sought to ascertain how students feel about using computers for learning. A wide range of views has been expressed by students. For example, Said (1993) used computers for tutorial sessions in mathematics with a group of first year college students. He then sought their perceptions of the use of computers in mathematics classes. Of the 146 students, more than half felt that the use of computers should be stressed in mathematics tutorials, while a few felt the opposite way. In addition, 80% of the students thought that using computers caused learners to be more attentive and almost half felt that computers helped students to understand the mathematics better than did ordinary tutorials. Despite these generally positive views of the use of computers in these mathematics classes, there were some who had opposing opinions.

Johnston (1987) carried out classroom research in two secondary schools as a part of the evaluation of the effectiveness of microcomputers programs for language development in English classes. Language development programs were used over an eight-week period by one class in one of the schools. Data were also gathered from six classes in the second school in which the use of microcomputers was already established. Data were collected by attitude questionnaire, interviews and discussions. According to Johnston, few of the students had previous experience other than in the English classes and experience was mostly on computer games. Of the 144 students who completed the questionnaire, more than half felt that computers would be hard to use in English lessons. However, 67% felt that computers could assist learning, while 11% felt they could not. When students were asked to comment on their perceptions of their learning, their responses were concentrated mainly on the technical aspects like improved spelling, with very little mention of the higher-order skills that are often linked to using computers in education. In fact, Johnston reported that for some of the students, although using computers in their lessons was enjoyable, they felt that the computer assisted learning activities were not relevant to English as a school subject. Johnston felt that such pupils seemed to be expecting instructional rather than investigative or revelatory programs.

The students in the Johnston study were asked what they felt were advantages and disadvantages of using computers in their English classes. Advantages listed included ease of use, fun to use, and motivational value. For disadvantages, some of the students felt that learning on computers was boring, impersonal and potentially complicated. In addition, some felt that working with the computer "made you feel lazy as if it was just a free lesson where you could play games" (p. 51). Johnston noted that the quality of the software used could greatly influence students perceptions of the usefulness of using computers in their classrooms. She therefore suggested that it was possible that if poor pedagogically weak software was used, the students might enjoy using it initially, but as soon as the novelty value had faded, the students could reject it as unhelpful and useless.

Kinnear (1995) also explored students' perceptions of the usefulness of computers in the classroom. She found that prior to computer use in the classroom, students in her sample tended to agree that computers should be used in the classroom. The majority (over 80%) of them felt that they would like to be in a classroom in which computers were being used. In addition, the students agreed that computers would aid their understanding and learning, but were less certain about whether computers would help them to learn faster or lead them to help each other more. According to Kinnear, evidence suggested that the girls in the sample were noticeably less positive than were the boys. The girls' perceptions of usefulness of computers was even less positive after nine months of use in their classrooms.

The research seems to suggest that students could have negative opinions about the usefulness of computers in the classroom. This study is particularly interested in students' perceptions of their usefulness in mathematics classes. It is possible that the range of views found in other studies might be held by Barbadian students. As in the case of the students in Johnston's study, Barbadian students may like computers but may not think them appropriate for mathematics instruction. It is possible that what students might consider to be "doing maths" might not be in keeping with their knowledge of using computers. For example, a report of the use of computers in mathematics suggested that emphasis was placed on conjecturing and testing, formulating problems and engaging in enquiry and investigations, with less emphasis on manipulating symbols, calculations and algebraic manipulations (Hudson & Borba, 1999). But it is possible that for some students mathematics is about manipulating numbers and symbols to find a solution to a defined problem. For such students, using the computer in mathematics might be seen as fun, but not doing mathematics at all.

CONCLUSION

From this brief examination of some of the literature on computer attitudes, several things seem apparent:

- despite the attraction that computers hold for students, there are some who find working with them stressful;
- there is the general belief that girls are less positive about computers than are boys;
- experience with computers is a crucial factor that can affect how students feel about the machines ;
- students' computer attitudes could have an effect on their computer use; and
- studies of attitudes toward computers offer no definitive answers.

The differential results of the many studies conducted in this area may perhaps be attributed to the use of different research designs or even the fact that each research setting is different. Whatever the reason, it seems prudent that, when students are to be exposed to computers as a learning tool, as is the case in Barbados, their attitudes should be assessed so that efforts can be made to ensure that each one benefits as much as possible. It is for this reason that this study is both relevant and important. Johnston (1987) emphasized the need to assess students' attitudes to educational innovations like computer integration when she wrote that "pupils' attitudes are of crucial importance to the success or failure of educational approaches or media, for negative reactions [can] inhibit learning whereas positive ones [can] make pupils more receptive to the learning activities" (p. 47).

CHAPTER THREE

RESEARCH STRATEGY & DESIGN

INTRODUCTION

The proposed questions were investigated by means of a survey. It has been suggested (Cohen & Manion, 1994; Wiersma, 1995; Gay, 1996) that survey research involves the collection of data from members of a population to determine the current status of that population with respects to one or more variables. Survey research is also recommended when the goal is to assess different types of information such as attitudes, opinions, characteristics, and demographic information (Gay, 1996). This approach is therefore highly compatible with the purpose of this research, which seeks to describe the kinds of attitudes that students in Barbadian secondary schools may hold toward computers and their perception of the usefulness of these machines in mathematics classrooms.

Although surveys are sometimes viewed with suspicion by some who may doubt the truthfulness of the responses or are concerned about the sometimes low response rate, it seemed appropriate for this exploratory study, where it was necessary to collect data from a large number of persons in a short period. In addition, this study was concerned with students' perceptions and the data collection procedures did not present a threat to respondents and there was therefore no need to doubt the truthfulness of their responses. Also the data collection instruments were personally administered by the researcher to intact groups to be completed and returned immediately where possible. According to Bell (1993), this approach tends to increase the chances of obtaining the cooperation of the intended participants.

In order to conduct this study, data were collected from a sample of students from among the secondary school population in Barbados by means of an attitude scale, as well as a written paragraph about their perceptions of the use of computers in their mathematics classes. In addition, this study was used to conduct pilot interviews with some of the students in the sample. These interviews were intended to provide an opportunity to try out a schedule that was being designed for use in a proposed follow-up study. The data from the questionnaire were analyzed by statistical procedures, while qualitative procedures were applied to the paragraphs and the interview data.

ASSUMPTIONS OF THE RESEARCH

There are some assumptions associated with the structure of this study. Some are related to the nature of attitudes and others to the postpositivist paradigm (Lincoln & Guba, 1994) in which this study is positioned.

One assumption made is that persons' dispositions to an object, as revealed in their expressions of beliefs and feelings, whether favourable or unfavourable, are likely to affect how they behave toward the object. This assumption may be challenged by some (Brecker, 1984; Ajzen, 1988) who may suggest that the interference of other factors could cause a person to behave in a manner that is not consistent with expressed beliefs and feelings. Although this viewpoint is acknowledged, the position taken here is in harmony with Festinger (1957) who suggested that, left to themselves, people are more likely to act in harmony with their beliefs and feelings in order to avoid dissonance. Thus, it is assumed that under normal circumstances, most people would act in accordance with their attitudes.

Another assumption made was that knowledge of children's attitudes could be had by the use of instruments that seek to measure and quantify those attitudes. Some would reject the implication here that the researcher is the "expert" who can objectively interpret the meaning of the children's responses to an instrument and ascribe an attitude to them. Such persons may advocate an approach that allows the "subjects" of the research to interpret their own responses and thus come to an understanding of their own attitudes toward computers (Carr & Kemmis, 1986). Such a challenge could raise epistemological questions concerning the nature of knowledge, how it can be acquired and how it can be communicated to others.

According to Cohen and Manion (1994), those who adhere to a postpositivist perspective believe in the existence of an absolute "Truth" that can never be perfectly apprehended by humans. Adherents of a more interpretative perspective oppose this view, asserting that there is only "truth" that is personal, subjective and unique to the knower. Whatever one's perspective may be, it is prudent to be aware of the limitations of the position that was taken and to acknowledge these limitations. Therefore, no claims are made here that the information gathered for this research represent absolute Truth, but merely contribution to the accumulation of what is currently known about the phenomenon being investigated. In fact, since the researcher is not aware of any research into Barbadian children's computer attitudes, whatever is learned from this study may become the foundation upon which others build or which they may choose to challenge.

There may also be the criticism that the use of an instrument such as the attitude scale that was selected for data collection in this study reduces the respondents to mere objects to be investigated. However, the researcher was aware that the children can have interpretations and understandings of their own and that accessing these views could help to explain their attitudes toward computers. This awareness fueled the decision to allow the participants to write a paragraph about their perceptions of the usefulness of computers in mathematics classes and to explore the notion of conducting interviews with them to ascertain their interpretations of their actions. The mixture of quantitative and qualitative methods employed in this research is in keeping with the postpositivist paradigm as defined by Guba and Lincoln (1994).

ETHICAL CONCERNS

A number of ethical concerns emerged as this research was being planned and conducted. Appropriate actions had to be taken to ensure that the students who participated in this study were treated with respect.

First, there was the concern about using students in a school. Robson (1993) pointed out that when the cooperation of such a "captive" group is required, steps should be taken to ensure that they do not feel forced to participate. Students and children are under the authority of teachers and adults, who exercise power over them. They may therefore feel that refusal to be a part of such an exercise as this study could lead to reprisals. Bearing in mind Tuckman's (1994) reminder that students have a right not to participate in a study, the students in this sample were advised of the purpose of the research, and were given the option of participating or not. They were reassured that, should they decline from participating, no actions would be taken against them. They were allowed to examine the instrument and ask questions before deciding.

Another concern was that of confidentiality and anonymity. The participants were asked share personal feelings with a stranger. Under such circumstances, it is advised that precautions be taken to ensure anonymity and confidentiality (Robson, 1993; Burns, 2000). To ensure anonymity, students were not required to write their names or anything by which they could be identified on the questionnaire. These questionnaires were returned anonymously. Since anonymity was not possible for the students who were interviewed, they were assured of confidentiality in that their real names would not be used in any reports of this research. In addition, the students' permission was sought whenever these interviews were audiotaped.

Finally, in order to ensure wider anonymity, the names of the schools involved in this research were kept out of the report.

THE SCHOOLS

Two secondary schools, School A and School B, were used in this study. These schools were selected from among those in which the pilot programme of computer integration is to be introduced in the 2000 – 2001 academic year. Both schools are coeducational, with School A having a roll of about 930 and School B about 780. There are however differences among the student body and organization of the two schools.

Each year, students are transferred from primary schools to the 23 government secondary schools based on their performance on an examination taken at the end of their primary education. The students' scores are ranked and they assigned to a school based on that ranking. Thus, the secondary schools are in effect themselves ranked. In the four-year period prior to this study, 1996 – 99, the intake of School B has placed it among the top six schools, while School A has been among the bottom six. The choice of these two schools therefore has led to the inclusion of students of differing abilities. Both School A and School B are divided into five year groups. However, at School A, the fifth year is divided into lower fifth and upper fifth.

Both schools are equipped with computer rooms that are primarily used by students in the fourth and fifth forms for information technology classes. Students in the lower year groups and those who are not studying information technology have very limited access to the computer rooms. However, both schools are currently being equipped with more computers in preparation for the computer integration pilot programme.

THE PARTICIPANTS

In order to be able to investigate attitudes to computers in different age groups, it was decided that only students from the first and fourth years of the two selected schools would be involved. This made the entire data gathering exercise more acceptable to the schools' principals, who were concerned that the schools should be disrupted as little as possible. It also made the task more manageable in the time available.

The population comprised 146 first year and 179 fourth year students at School B and 186 first year and 219 fourth year students at School A. At both schools, the first year students generally fell in the 11 – 12 age group, and the fourth year students in the 14 – 15 age range. Using the secondary schools' entry examination as a guide, this population included students of somewhat above average ability and some performing somewhat below average.

Originally, the research was planned to include the entire population since it was believed that it was both accessible and of a manageable size. However, the constraints of the reduced time for data collection, as well as the end of term activities at the schools did not allow for multiple visits to the schools or extended periods over which data could be collected. The students from whom data were collected therefore represent a sample of the intended population, selected by a non-probability method and this may therefore introduce some bias in the results.

Although the assisting staff at both schools asserted that the students who were available were typical of the targeted year groups, there was no way of confirming this. In addition, since the questionnaire was anonymously completed, there was no way of checking who the non-respondents were. This made it impossible to check for systematic bias in the sample. The researcher therefore accepted the staff's assessment of the representativeness of the sample.

TABLE 3-1: The Numbers of Students in the Research Sample, Shown by School, Gender and Year Group.

		FIRST YEAR	FOURTH YEAR	TOTAL
School A	MALE	46	34	80
	FEMALE	46	46	92
School B	MALE	46	48	94
	FEMALE	52	46	98
	TOTAL	190	174	364

Questionnaires were administered to 384 students, 193 from School B and 191 from School A. However, 20 (19 from School A and 1 from School B) of these had to be discarded either because the student completed only half of the items or neglected to indicate a gender. Of those discarded, 12 were males, 6 female, and 2 of unknown gender. Thus, data were recorded from only 364 students. Of that number, 190 were from the first year while 174 from the fourth year, and 190 were female with 174 being male (Table 3-1). This sample was deemed appropriate in light of the research questions, which required the exploration of relationships between computer use and attitudes and the age and gender of students.

The Interview Sample

The original plan called for a sample of eight students, 4 male and 4 female, purposively selected by the schools' staff. However, because no boys from one school consented to be interviewed, this sample was finally made up of two male and six female students. There was therefore an under-representation of the views of male students in the data collected. This possibility should be borne in mind when the results from the interview exercise are interpreted.

This sample consisted of three girls and one boy from each of the two year groups. All the students were fairly articulate and willing to share their views on the subject of computers and their use. They all consented to having the interviews recorded.

INSTRUMENTS

Data was collected by means of a two-part questionnaire, a written paragraph and short pilot interviews. Part of the questionnaire was an attitude scale. As mentioned before, attitude is a construct and cannot be directly measured, so it must be inferred from verbal or non-verbal responses. According to Ajzen (1988), attitude scales are the most commonly used method of assessing attitudes by verbal responses and Green (1954) pointed out that, when properly constructed, they can be very reliable. However, attitude scales are subject to the difficulties associated with self-report instruments. For example, Robson (1993) pointed out that data collected by this method are necessarily superficial and that there is little or no way of checking the honesty or seriousness of the responses.

These difficulties did not seem to negate the usefulness of data collected by an attitude scale. This study was concerned with the students' perceptions of their actions, and it was assumed that if the students freely consented to participate in the research, then they would complete the questionnaire as honestly as they could. Thus, a Likert-type scale was used. Following is a description of the instruments used in this study.

The Questionnaire

The questionnaire was made up of two parts. The first part dealt with demographic information that addressed the gender, year group and computer experience of the students. Three items about computer experience were included. The first item required the students to select Never, Sometimes or Often to indicate their perceptions of the frequency with which they used the computer for a list of activities. For the second item, they were asked to indicate, by selecting Yes or No, the places where they have or have had access to computers, while the third item sought to ascertain the frequency with which they use computers alone or with other people. As with the first item, the provided responses were Never, Sometimes and Often.

This information was deemed relevant since research has indicated that there might be age and or gender differences in the use of (Kinnear, 1995) and access to (Sutton, 1991) computers. In addition, there is the sometimes-held perception that those who are confident and enthusiastic about computers spend more time working alone on the computer than those who are less so. This prompted the inclusion of the item that asked students to indicate the frequency with which they work alone or with others on the computer. It was anticipated that the data gathered by means of these items could be used to ascertain whether such suggested trends about computer use and access hold true for the participants of this research, and whether they are in any way related to computer attitudes.

The second part of the questionnaire contained the Computer Attitude Scale (CAS) designed by Loyd and Gressard (Appendix 1). The CAS consists of 30 items, which present statements of attitudes toward computers and the use of computers. Three dimensions of computer attitudes are represented – (1) anxiety or fear of computers, (2) liking of computers or enjoying working with computers, and (3) confidence in ability to use and learn about computers (Loyd & Gressard, 1984b). There are ten items associated with each of these dimensions. The 30 statements were accompanied by a five point Likert scale, ranging from strongly agree to strongly disagree and the students were required to select the response that best expressed the degree of their agreement with each statement. The scale, which contains both positive and negative statements, was designed to be used as a single unit, or the three subscales may be used individually.

The CAS was selected because it has been proven to be very reliable when used with different samples. Loyd and Gressard (1984b) reported coefficient alpha reliabilities of 0.86, 0.91, 0.91 and 0.95 for the Computer Anxiety (CA), Computer Liking (CL), Computer Confidence (CC) subscales and the Total Score respectively, when the instrument was used with 155 eighth through twelfth – grade students in the United States. In addition, Woodrow (1991) conducted a study to compare four different computer attitude scales, including the CAS. The sample for this study was 98 preservice student teachers, the majority of whom were female and all of whom were computer novices. She reported reliability coefficients 0.80 for the CA subscale, 0.85 for the CL subscale, 0.86 for the CC subscale and 0.94 for the Total Score. These compared well with those reported by Loyd and Gressard (1984b), and again demonstrated the high reliability of the instrument.

The selection of the CAS was also influenced by the Woodrow (1991) study in that this study showed that this instrument compared favourably with the other computer attitude scales, but had the added advantage of addressing the three dimensions of anxiety, liking and confidence that are linked to the affective and behavioural domains. However, according to Woodrow, the CAS did not assess attitudes in the cognitive domain. A decision was made to use this attitude scale despite this, since it appeared to be the most reliable of the scales available to me at the time. In addition, it could be scored as a single scale or as three subscales and it had been used among secondary school students before. It was thought that these characteristics were an adequate trade off for the lack on items on the cognitive domain.

Despite the positive reports that Woodrow (1991) gave about the CAS, she did raise a question about it. Based on a factor analysis on the data collected from the 98 student teachers, Woodrow suggested that the items on the attitude scale loaded almost exclusively on two factors, and she interpreted this to mean that the instrument was perhaps two dimensional instead of three dimensional. She also suggested that the three subscales might not be stable enough to be used as separate scores. She offered two possible reasons for these results, namely that the stability of the CAS could have been affected by its integration with the other three scales when they were administered, and second, that the size of the sample could have tainted the results of the factor analysis. With these possibilities in mind, it was decided that the CAS would still be used, but that, following Woodrow's advice, a factor analysis would be carried out on the data collected to check the stability of the subscales before they were interpreted.

Piloting the Attitude Scale

Despite the reports of highly reliability of the CAS, it was decided that this scale should be piloted in a Barbadian context to ascertain whether the language used for the items would be clear to the students. This was deemed necessary because many Barbadians primarily speak the local dialect, with Standard English as a second language. Although the majority of them read Standard English very well, it was necessary to ensure that there were no problematic idioms on the CAS, which was developed in the United States.

For the piloting exercise, the 30 statements were arranged in alphabetical order, a few demographic items were added and the resulting instrument was sent by electronic mail to a secondary school in Barbados. There, two teachers administered it to 62 students, 20 first-year students and 42 fourth-year students, 30 girls and 32 boys. A checklist of questions to be answered by the pilot sample was also sent. These questions were designed to collect feedback on the attitude scale. As a result of this feedback, two minor changes were made to the instrument. The item that originally read "I get a sinking feeling when I think of trying to use a computer" was altered to read "I get an anxious feeling when I think of trying to use a computer". Also in the item which read "When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer", the word "run" was replaced by "program". For the pilot group, a reliability coefficient of 0.79 was obtained.

After these adjustments were made, the two parts of the instrument were put together and the questionnaire (Appendix 2) was reviewed by an expert in questionnaire design, who deemed it adequate for use. A cover letter (Appendix 4) was then prepared to accompany the questionnaire. This letter explained the nature of the research and sought the students' cooperation.

The Written Paragraph

In order to properly address the research questions, it was necessary to find out about students' perceptions of the usefulness of computers in mathematics lessons. For this purpose, it was decided that the students should be asked to express their views in a paragraph. This approach was considered appropriate because it was believed that the students should be allowed to freely express their opinion instead of merely selecting prepared responses. However, there was some anxiety about using this as a means of collecting data.

First there was the concern that less able students might not want to write the paragraph, not because they did not have an opinion, but because they might have difficulty putting it in writing. Second, some students might have difficulty expressing a more than superficial opinion at short notice. Although these concerns were not dismissed as trivial, it was still decided that this approach should be used and that all efforts would be made to encourage the students to express their views even if they were not written in grammatically correct forms.

After this decision was made, the item was formulated and it was reviewed. When the item was deemed adequate, instructions were added (Appendix 3).

The Interview Schedule

Since this research is being used to inform follow-up research, it was decided that interviewing should be explored as a means of gathering information from the participants. Although the attitude scale and the written paragraph were the main data collecting tools for the current research, it was anticipated that these measures would be insufficient for the larger follow up research project. Interviews were considered because they provide respondents with an opportunity to give extended responses, they allow for modification and clarification of questions as well as probing. Since interviewing can produce rich data, it was decided that this approach should be explored as a data collecting strategy. However, attention was paid to the drawbacks of interviewing. For example, Robson (1993) pointed out that interviews could be time-consuming. This is true not only for the conducting of the actual interview, but also for transcription. In addition, considerable skill is needed for carrying out effective interviews.

With these considerations in mind, a decision was made to use the current research to explore the use of interviewing as a means of collecting data. This decision was based on the admonition of writers in research methods (Gay (1996; Gall, Borg & Gall, 1996) who suggested that piloting is an essential part of developing an effective schedule. These pilot interviews therefore provided the researcher with an opportunity to gauge her skills in this area and to ascertain whether or not further training and experience would be needed.

The interview schedule that was piloted was constructed by the researcher. First, broad areas of interest were identified. These areas included knowledge about computers, access to and use of computers, general feelings about computers, and feelings about the use of computers in the classroom. A number of questions related to these areas was formulated. These questions were reviewed by a colleague, who suggested that some questions needed to by reworded and others to be discarded. The resulting adjusted schedule (Appendix 5) was compiled to be tested. It should be noted that perhaps the schedule should have been pretested before the actual piloting exercise. However, the constraints of time did not allow for this and the schedule was used for the first time with the participants of this research.

PROCEDURE

Initial contact was made via the telephone with School A several weeks prior to the data collecting activity. Further contact with this school was made by mail about one week prior to the first visit there. One week before the data was collected, the researcher visited the principal to present the letter of endorsement from her supervisor and to make arrangements for making contact with the students.

Contact was made with the Deputy Principal of School B via telephone since efforts to speak with the principal directly proved to be futile. The purpose of the research was explained and consent was given for the distribution of the research instruments and the conducting of the interviews. Arrangements were then made for contact with the students.

In designing this research project, the data collecting activities were schedule for March 20 – 31, 2000, the last two weeks of the second term. However, the schools were both participating in the island's inter-secondary schools athletics championships that were being held during the week of March 20 – 24 and it was not possible to have access to the students during this time. As a result, the time for conducting the research was reduced to five days, March 27 – 31.

Data Collection

School A

The questionnaire was administered at this school during the afternoon session of Day 1 of the data collection period, on the advice of the two assisting Year Heads. The researcher visited all of the first forms that were available. In each form, the essence of the questionnaire's cover letter was delivered to the students by the researcher. They were told the purpose of the research and their assistance was requested. Students were told that they were free to refuse to participate in the research project, and could leave the room if they so desired. No students present at these classes openly declined from filling out the questionnaire and writing the paragraph. Questionnaires were then distributed to all that remained in the room and the topic for the paragraph was read.

In at least one of the first forms, the researcher had to read the questionnaire to the students because of their limited reading ability. When this was not required, the students were left under the supervision of their teacher to complete the questionnaires. These teachers were instructed to help students with any words that they found difficult. In each classroom, a copy of the topic for the paragraph was left with the supervising teachers so that students could be reminded of the topic if necessary. In all cases, an envelope was left in which the students were instructed to place their completed questionnaires. Of the six first forms at the school, the questionnaire was administered to five. The sixth form was on the playing field at the time of administration.

A similar procedure was followed among the fourth form students. However, these students were in subject groups instead of in their classes. Five such groups were visited and the questionnaire had to be read to one group. Two of the fourth form students had difficulty understanding the meaning of Item 4 on the attitude scale and this had to be explained by the researcher. Again the students were left under the supervision of a teacher with instructions similar to those given to the first form teachers, and an envelope was left behind for the completed questionnaires. Of the seven fourth forms at the school, students from five completed the questionnaires.

Since it was the end of the school day when the questionnaire administration was completed, arrangements were made for the researcher to return to the school on the following afternoon to conduct interviews. Because these interviews were a pilot for more in depth sessions to be conducted in follow up research, the two heads of the year groups were each asked to select one boy and one girl from among their respective charges. This approach was deemed appropriate since the object of this exercise was to determine whether the interview items would yield the type of information required. It was therefore important to interview students who were articulate. The probability of finding such students was higher if they were selected by teachers who knew them than if they were randomly selected by the researcher.

The four interviews were conducted on Day 2. The students were interviewed individually in either a vacant classroom or the Guidance Counsellor's office. The interviews were recorded with the students' permission.

School B

After permission was granted by the Deputy Principal for the research to be conducted among the students of the school, questionnaire data were collected over a period of two days, Days 2 and 3. The end of term activities at the school did not permit the researcher to personally administer the questionnaires. These were left with the Head of the Computer Department to be administered at the school's convenience. The questionnaires were accompanied by several copies of the cover letter to the students as well as a number of sheets outlining the topic of the paragraph to be written by the students.

The Department Head personally administered the questionnaires over the two-day period. He reported that he visited each form in the first and fourth years, informed the students of the purpose of the research by reading the cover letter and asked them to participate. The questionnaires were then distributed to all who expressed a desire to participate. As a result, some students from all the first forms and all the fourth forms participated.

As with School A, the Head of Department was asked to select one boy and one girl from each of the two year groups to be interviewed. However, he reported that none of the boys approached wanted to be interviewed, which led to four girls being selected, two first year students and two from the fourth year. These interviews were conducted on Day 5, the last day of the school term, after the school's formal dismissal. The students were interviewed in the Guidance Counsellor's office and in all cases, the students agreed to have them recorded.

COMPILING THE DATA

The Questionnaire

In order to prepare the questionnaire data for analysis, coding and scoring had to be done. The first part of the questionnaire was coded as categorical data. The items that were accompanied by a three point scale were scored 0 to 3, where 0 indicated that the respondent did not select a response for the item; 1 denoted a choice of the NEVER option; 2, the choice of the SOMETIMES option; and 3, a choice of the OFTEN option. The item that provided two options was scored with 0 for a lack of responses, 1 for NO and 2 for YES. Thus, ranked data were obtained, with the lower numbers indicating the less favourable responses and the higher numbers, the more favourable. Nominal codes were used to indicate the school, gender and year group of each participant.

The CAS was attached to a five point Likert-type scale, with options of Strongly Agree, Agree, Unsure, Disagree and Strongly Disagree. For the Confidence and Liking subscales, positive items were scored from 5 for Strongly Agree to 1 for Strongly Disagree, while negative items were scored in reverse order. Thus, higher total scores on these two subscales indicate more positive attitudes. The Anxiety subscale was scored similarly, so that the higher total scores indicate lower levels of anxiety. Overall then, for the 30 items, higher scores indicate more positive attitudes. For the CAS, 0 was also used to indicate no response.

The Written Paragraph

The responses to the question about perceptions of the usefulness of computers in mathematics classes were recorded in a table, along with the corresponding gender and year group of the respondent.

The Interviews

The interviews were transcribed by the researcher. There was a feeling of uneasiness about the whole interview process. However, it was a trial exercise and several valuable insights were gained that will be very useful in the larger follow-up study. For the current study, data from the interviews were used for illustrative purposes, since no new ideas were forthcoming.

ANALYSIS OF THE DATA

The data from the 364 questionnaires were analyzed using SPSS 9.0 computer software.

The first part of the questionnaire provided data about the age, gender and computer experience. Although the students were asked to indicate their form, this was used to determine their age group since generally, students in the first are in the 11 – 12 age group and those in the fourth form in the 14 – 15 age group.

These items yielded nominal and ordinal data, and hence when the computer experience of the sample was analyzed by gender and age, nonparametric procedures, namely the Mann-Whitney test were used. According to Siegel & Castellan, (1988), this test is the most powerful of the nonparametric tests, and is suitable when the measurement in the research is weaker than interval scaling. The Mann-Whitney procedure tests whether two independent groups have been drawn from the same population, that is, whether they have the same distribution. With the computer software, the tests' scores are converted to a *Z* score, and a corresponding probability level is given.

One approach to reporting these results in a study requires that the calculated Mann-Whitney *U* statistic, the sizes of the samples and the corresponding probability level be reported (Burns, 2000; Brace, Kemp & Snelgar, 2000). In this study however, the *Z* scores[*] are given because the notion of the normal curve and its relationship to probability level is familiar to many persons and it was felt that this might make more sense to readers than the *U* statistic. For this study, probability levels of 0.01 or smaller were taken to be significant.

Following the advice of Woodrow (1991), a factor analysis was carried out on the thirty items on the Computer Attitude Scale (CAS) to investigate the stability of the subscales. A principal component factor analysis with varimax rotation was done. The resulting factors were compared with the three subscales of Loyd and Gressard to ascertain whether they were similar or different.

The CAS yielded interval scores and t-test seemed appropriate. However, it appeared that some of the assumptions needed for parametric testing were violated. Gall, Borg and Gall (1996) advised that, when in doubt about this, both parametric and nonparametric tests should be run. If these tests yield different results, then the nonparametric results should be used. When this was done for the data collected for this study, significantly different results were found and therefore the nonparametric tests were used. Thus for the analyses, Mann-Whitney and Kruskal-Wallis tests were used. The Kruskal-Wallis test is the nonparametric equivalent of the analysis of variance test. It is used when the three or more independent groups are to be compared on a single variable.

The students' paragraphs were separated into three groups, those who spoke favourably of computers in mathematics classes, those who gave negative responses and that whose responses suggested a state of ambivalence. Each group of responses was examined for recurring themes.

[*] For the conversion formula, see Siegel and Castellan (1988), pp. 132.

CHAPTER FOUR

RESULTS & DISCUSSION

This study investigated the attitudes that some students in Barbadian secondary schools hold toward computers, and their perceptions of the usefulness of these machines in mathematics classes.

Data were analyzed according to the gender, age and computer experience of the students in the sample. Since the literature (e.g. Sutton, 1991) suggested that computer experience was not only a key factor in computer attitudes, but also was a function of gender and age, the data were analyzed to ascertain to what extent this was so for this sample.

COMPUTER ACCESS

The students in the sample were asked to indicate where they have or have had access to computers. A list of places was provided, with additional spaces provided for them to include other places. Although other places were listed, they were given by so few students that they did not merit inclusion in the list.

TABLE 4–1: Students' Access to Computers by Gender and Form (Age).

PLACE OF ACCESS	GIRLS			BOYS			FORM 1			FORM 4		
	Yes	No	TOTAL	Yes	No	TOTAL	Yes	No	TOTAL	Yes	No	TOTAL
At home	94	77	171	91	70	161	106	71	177	79	76	155
At a friend's house	92	77	169	98	64	162	95	83	178	95	58	153
At a relative's house	97	72	169	87	74	161	88	88	176	96	58	154
At primary school	51	95	146	43	107	150	74	95	169	20	107	127
At secondary school	62	105	167	82	76	158	20	150	170	124	31	155

Access to Computers by Gender

Table 4-1 shows the number of boys and girls who reported that they use or have used a computer at home, at the home of a friend or relative or at school. The results of a Mann-Whitney tests indicated that girls and boys differed significantly only in their access to computers at their secondary school ($Z = -2.676$, $p = 0.007$). Differences in access to computers in school were discussed by Sutton (1991) who showed that, of fifteen studies she examined, seven presented data that, although not statistically significant, favoured boys, and three reported statistically significant differences favouring boys. The findings of the current study confirmed that, among the sample used, boys seemed to access computers in school significantly more than girls.

Lockheed (1985) summarized the findings of a number of studies and reported that boys were significantly more likely to have greater access to and report more frequent use of computers at home than do girls. She suggested that inequality of home access could contribute to the more positive computer attitudes often found among boys. In this study however, 55% of the 171 girls and 56.5% of the 161 boys who responded to this item reported that they have home access to computers. This lack of significant gender differences in home access to computers is contrary to the finding of Kirkman (1993) who found that significantly more boys than girls (38% of the 102 girls and 70% of the 97 boys) in his sample used a computer at home. It also contradicts Sutton's observation that families of boys were more likely to own a computer than families of girls

Access to Computers by Form (Age)

Table 4-1 also indicates the number of older and younger students who reported having access to a computer in the places listed. Mann-Whitney tests revealed that the older and younger students in the sample did not differ significantly in their use of computers at home, and at the homes of their friends and relatives. On the other hand, the younger students were shown to have significantly more access to computers (44% of 169 from Form 1 vs. 16% of 127 from Form 4) at their primary schools ($Z = -5.12$, $p < .0005$). In addition, the older students (80% of

127 from Form 4 vs. 12% of 169 from Form 1) reported significantly more access at secondary school than did the younger students ($Z = -12.35$, $p < .0005$).

This finding is likely to be due to the fact that the older students would have left primary school before computers became available in the majority of the schools at this level and before computers were seen as more than a device for rewarding classroom performance. The greater access that the older students have at secondary school may be linked to the fact that information technology is usually introduced in the fourth year curriculum. As one student reported in the interviews, only students involved in the information technology classes tended to have ready access to the computer rooms at her school.

COMPUTER USE

On the questionnaire, a list of activities was provided and the students were asked to indicate the frequency with which they used a computer to do these activities. In addition, spaces were provided for the students to include activities not shown in the list. Ten such activities were given, but each of these was given by less than four students. These activities were therefore not included in the analyses.

Computer Use by Gender

TABLE 4–2 : Students' Use of the Computer by Gender

	GIRLS				BOYS			
ACTIVITIES	**Never**	**Sometimes**	**Often**	**TOTAL**	**Never**	**Sometimes**	**Often**	**TOTAL**
Play games	16	125	44	185	14	102	58	174
Do schoolwork	62	59	59	180	46	62	57	165
Do homework	87	56	32	175	65	58	45	168
Use the internet	77	55	43	175	53	60	58	171
Programming	102	40	18	160	95	51	16	162
Drawing & Designing	49	86	37	172	55	76	34	165

Table 4–2 shows the number of girls and boys who reported their use of computers for the listed activities. Mann-Whitney tests were run to ascertain whether the frequency with which these two groups use computers for these activities differed significantly. A significant difference was found only for the use the Internet ($Z = -2.572$, $p = .010$). This particular finding was puzzling but a possible explanation was suggested by one of the girls interviewed. She believed that girls avoided the Internet because they were afraid of coming in contact with unsavoury characters who could hurt them.

One interesting finding is the lack of significant difference in frequency of use of computers for playing games and programming. According to Lockheed (1985), males use computers more than females for programming and game playing, but not more for other computer applications and this has been confirmed by other studies (Hess & Miura, 1985; Wilder et al., 1985; Hawkins, 1985; Linn, 1985, Harris, 1999). The lack of significant difference found here might perhaps be due to changes in computer software. Perhaps recent computer games are less male-oriented than were earlier types. Similarly, programming languages and skills may have become less dependent on mathematical ability than previously. These are factors that have been identified as contributing to the lack of appeal that computer games and programming had for girls. In light of the findings of earlier studies, further investigations would need to be done to ascertain the extent to which Barbadian girls and boys are engaging in certain activities on the computer, and to establish factors that influence their choices of activities.

Computer Use by Form (Age)

TABLE 4–3: Students' Use of the Computer by Form (Age)

	FORM 1				FORM 2			
ACTIVITIES	Never	Sometimes	Often	TOTAL	Never	Sometimes	Often	TOTAL
Play games	12	107	69	188	18	120	33	171
Do schoolwork	70	46	66	182	38	75	50	163
Do homework	82	45	57	184	70	69	20	159
Use the internet	69	58	57	184	61	57	44	162
Programming	99	58	19	176	98	33	15	146
Drawing & Designing	54	86	40	180	50	76	31	157

Some of the students interviewed expressed the view that older and younger children used computers differently. They believed that younger children played more games than older children while older children did more schoolwork and homework. The numbers of students who reported using the computer are given in Table 4–3. Statistical tests revealed that the frequency with which the younger and older students in the sample tended to use computers differed significantly only for playing games ($Z = -3.639$, $p < .0005$). The younger students reported playing games significantly more often than the older students, and a significantly greater number of older students reported that they played sometimes.

Analyses were also carried out within the two gender groups. The results indicated that among the older and younger girls in the sample, there was no significant difference ($Z = -1.576$, $p = .115$) in the reported frequency of game playing. However, among the boys, the younger ones reported playing games significantly more frequently then the older ones ($Z = -3.463$, $p = .001$). Further analyses were done to compare the frequency of game playing reported by younger boys and older girls and between younger girls and older boys. The results indicated that the younger boys played computer games significantly more often than did the older girls ($Z = -3.914$, $p < .0005$). There was no significant difference for the younger girls and older boys ($Z = -1.378$, $p = .168$)

The matter of computer games is certainly of interest because they are likely to be the first contact that many persons have with computers. Quite often this is the only contact that younger children have with the computer, and so they may associate the computer with fun. On the other hand older students would have been introduced to information technology at school and may have another view of computers (Wilder, Mackie & Cooper, 1985). This idea was articulated by 12-year-old Charlene during an interview. She said:

> Older people use computers for their business work and younger children, well they would just see the computer just for sport. Like children at primary school they would use the computer just for sport, but children at secondary school would use them for more advanced work, like their SBAs (school-based assessment) or stuff like that.

However, it is interesting to note that although not statistically significant, a greater proportion of the younger students (36%) than the older students (31%) reported using the computer often to do schoolwork. It is also worth noting that a greater proportion of younger students (39%) than the older students (23%) reported that they *never* used computers for schoolwork.

The above results indicate that for this sample, more boys had access to computers at secondary school than did girls, that more of the younger students had access to computers at primary school than did the older students, while at the secondary school, the older students used computers more. In addition, the boys used the Internet more often than did girls and generally, the younger students played games more often than the older ones. However, when the frequency of playing games was examined along the line of age and gender, the younger boys played games significantly more often than the older boys and older girls.

FACTOR ANALYSIS

An initial reliability analysis was carried out on the 30 items of the Computer Attitude Scale (CAS) and the three subscales. According to Wiersma (1995), reliability is the degree to which an instrument will give similar results for the same or similar individuals at different times. A Cronbach Alpha coefficient of 0.84 was found for the whole scale. Reliabilities of 0.60, 0.76, and 0.59 were found for the Anxiety, Confidence and Liking subscales.

On the advice of Woodrow (1991), the items of the CAS were subjected to a principal components factor analysis with varimax rotation to investigate the stability of the three subscales. An extraction analysis yielded nine factors with eigenvalues greater than 1, accounting for 59% of variance. However, guided by a Scree plot, four factors, accounting for 41% of variance, were extracted and rotated. A decision was taken, based on the experience of others (Reece & Gable, 1982; Woodrow, 1991) to accept as valid contributors to a factor only those items with loadings of 0.4 and greater. Twenty-seven of the thirty items loaded on these four factors (Figure 4 – 1). Factor 1 was judged to identify feelings of fear of and anxiety toward computers.

FIGURE 4-1: *Details of the Factor Analysis Showing the Loadings on Each Item*

Item No.	Item	Factors			
		1	2	3	4
24	I'm not the type to do well with computers.	0.657			
30	Working with a computer would make me very nervous.	0.653			
3	Computers make me feel uneasy and confused.	0.652			
11	I do not think I could handle a computer course.	0.647			
23	I'm no good with computers.	0.609			
17	I think using a computer would be very hard for me.	0.600			
14	I feel aggressive and hostile toward computers.	0.560			
12	I don't think I would do advanced computer work.	0.556			
13	I don't understand how some people can spend so much time working with computers and seem to enjoy it.	0.516			0.434
19	I will do as little work with computers as possible.	0.482			
2	Computers make me feel uncomfortable.	0.459			
15	I get an anxious feeling when I think of trying to use a computer.	0.420			
*28	The challenge of solving problems with computers does not appeal to me.				
18	I think working with computers would be enjoyable and stimulating.		0.627		
21	I would feel comfortable working with a computer.		0.624		
20	I would feel at ease in a computer class.		0.619		
22	I would like working with computers.		0.618		
6	I am sure I could do work with computers.		0.537		
7	I am sure I could learn a computer language.		0.510		
8	I could get good grades in computer courses.		0.494		
26	It wouldn't bother me at all to take computer courses.		0.473		
27	Once I start to work with the computers, I would find it hard to stop.		0.452		
16	I have a lot of self-confidence when it comes to working with computers.		0.431		0.427
25	If a problem is left unsolved in a computer case, I would continue to think about it afterward.			0.629	
5	Generally, I would feel OK about trying a new problem on the computer.			0.615	
29	When there is a problem with a computer program that I can't immediately solve, I would stick with it until I have an answer.			0.569	
*9	I do not enjoy talking with others about computers.				
4	Figuring out computer problems does not appeal to me.				0.610
10	I do not feel threatened when others talk about computers.				0.570
*1	Computers do not scare me at all.				

* Did not load on any of the factors

Factor 2 was labeled as enthusiasm (enthusiasm and confidence for working with computers). Factor 3 suggested persistence with computer tasks, while Factor 4 suggested a measure of indifference toward computers.

TABLE 4–4: Correlation Coefficients for the Original Three Subscales and the Four New Subscales

	Anxiety	Confidence	Liking
Fear/Anxiety	0.762**	0.770**	0.658**
Enthusiasm	0.530**	0.691**	0.557**
Persistence	0.209**	0.387**	0.500**
Indifference	0.485**	0.481**	0.635**

** $p < 0.0005$

A reliability coefficients of 0.85 was found for the resulting 27-item scale, and coefficients of 0.83, 0.78, 0.51 and 0.43 were found for the Fear/Anxiety, Enthusiasm, Persistence and Indifference subscales respectively. These subscales correlated moderately to highly with Loyd and Gressard's three subscales of Anxiety, Confidence and Liking (Table 4-4). The four subscales found by this factor analysis were used in the assessment of the computer attitudes of the students in the sample used for this study. For the Enthusiasm and Persistence subscales and the Whole Scale, high scores indicate positive attitudes, while high scores on the Fear/Anxiety and Indifference subscales indicate low levels of fear and indifference respectively.

THE STUDENTS' ATTITUDES TOWARD COMPUTERS

TABLE 4-5: Students' Means and Standard Deviations for the Modified Attitude Scale and the Four Subscales

	Mean (N = 364)	Standard Deviation
Fear/Anxiety	3.8	0.771
Enthusiasm	4.2	0.604
Persistence	3.8	0.787
Indifference	3.6	0.827
Whole Scale	4.0	0.502

On the attitude scale, means were calculated for each student on each of the five attitude measures. Table 4-5 shows the overall means and standard deviations of the sample on these measures. A mean of 3 indicated a neutral attitude. Generally, then the means in the table suggested that, the students in the sample held positive attitudes toward computers. They seemed to be enthusiastic about using computers and indicated that they would persist with computer tasks. In addition, they seemed to experience slightly low levels of fear and anxiety and slightly indifferent attitudes to computers.

The finding of overall positive attitudes toward computers here is consonant with the findings of several studies conducted in different settings with different instruments (Harvey & Wilson, 1984; Nelson, 1988; Kinnear, 1995). There are several reasons that may account for these positive attitudes among the Barbadian sample. For example, in Barbados, the computer integration programme was being sold to the public via the news media. Students may have been attuned to the discussions about how computers will revolutionize learning, making it more fun, more meaningful and more individualized. In the written paragraphs about using computers in mathematics, several students mentioned the "fun" aspect of learning with computers, and many wrote of learning at their own pace. Eleven-year-old Deonne captured the essence of this overall positive feeling. During an interview, when asked why she wanted to work with computers, she responded:

> "(Be)cause the computer is more fun than watching a teacher when you can interact with the computer. You can't have much interaction with the teacher because the teacher has to be paying attention to all the other children while it is just you and the computer."

In addition, 90% of the sample reported that they played games on the computer (Table 4 – 3). Again, it is possible that the students associated computers with an activity that they enjoy, and this could have contributed to their generally positive attitudes. In fact, this finding is similar to that of Harvey and Wilson (1985) in which a large proportion of the sample reported using computers for playing games and who when asked to write about their feelings about computers, largely referred to them as objects of fun and enjoyment.

GENDER AND COMPUTER ATTITUDES

The sample consisted of 190 girls and 174 boys. In order to investigate gender related computer attitudes, a series of Mann-Whitney tests was run on the scores for the four attitude components and for the whole scale. On all five measures, the results indicated that the boys and girls held similar attitudes toward computers (Table 4–6).

TABLE 4–6: The Results of Mann-Whitney Tests on the Scores for Girls and Boys on the Four Components of the Attitude Scale and the Whole Scale.

	Fear/Anxiety	Enthusiasm	Persistence	Indifference	Whole Scale
Z	-0.504	-0.984	-0.237	-0.191	-0.833
p	0.614	0.325	0.812	0.849	0.405

This finding is contrary to those of many research studies conducted in this area. For example, Kirkman (1993) suggested that boys were more enthusiastic and more confident about computers, and Kirkpatrick and Cuban (1998) were concerned about the negative attitudes toward computers that they said existed among females. In addition, Brosnan (1998) suggested that girls were more likely than boys to suffer from "computerphobia". However, the finding here supports those of Loyd and Gressard (1984a) and Kinnear (1995) who reported that they found no gender differences among their samples.

One of the reasons given when gender related computer attitudes are found is that the computer tends to have a masculine image. In the early days of microcomputers, programming was very prominent and it was suggested (Hawkins, 1985) that the association between computers and mathematics, a subject traditionally avoided by girls, could be responsible for any negative computer attitudes displayed by girls. However, in the two schools from which the sample of this study was drawn, computers are associated with the less threatening "IT", a subject which according to Brosnan (1998), tends to attract females. This could be a contributor to the absence of gender-related differences in computer attitudes.

AGE AND COMPUTER ATTITUDES

Students from two age groups were included in the sample. There were 190 first form students (11 – 12 years old) and 174 fourth form students (14 – 15 years old).

TABLE 4–7: The Results of Mann-Whitney Tests on the Scores for Form 1 and Form 4 on the Four Components of the Attitude Scale and the Whole Scale.

	Fear/Anxiety	Enthusiasm	Persistence	Indifference	Whole Scale
Z	-3.634	-0.060	-3.374	-0.763	-2.024
p	<0.0005*	0.952	0.001*	0.445	0.043

* Statistically significant at $p \leq 0.01$

The results of a series of Mann-Whitney tests indicated that there were age-related differences on two of the attitude components, Fear/Anxiety and Persistence (Table 4-7). The younger students were significantly more fearful and anxious than were the older students, while the older students seemed to be more persistent with computer tasks than were the younger ones.

Loyd and Gressard (1984a), using the computer attitude components of Anxiety, Confidence and Liking, found that students in the 13 – 15 age group in their sample scored higher on the Liking subscale than did students in the three older age groups. However, they found no main effects for age on the Anxiety subscale. Harvey and Wilson (1985) found age related differences on four of the 20 items on a semantic differential scale, while Nelson (1988) found that younger students (5 – 10 years) in his sample showed more positive attitudes than did the older ones (11 – 15 years). The different results may have been due to the different measurement instruments and analysis techniques used, and this makes it difficult to compare the findings.

Brosnan (1998) suggested that lack of confidence and high levels of anxiety may be due to lack of experience. However, the analyses of the 14 items designed to assess computer experience indicated that the older and younger students in the sample differed significantly on only three:

1. access to computers in secondary school in favour of the older students,
2. access in primary school in favour of the younger students, and
3. frequency of playing games in favour of the younger students.

Perhaps these three areas of difference could offer some explanations for the high anxiety among the younger students. For example, it could be that the older students received formal instructions with computers in their IT classes and might feel more confident about their abilities. On the other hand, the younger students' game playing could be linked with their reported greater persistence with computer tasks. Perhaps they are more likely to persist with "fun" activities than if they were using computers for academic purposes like the older students.

TABLE 4–8: The Results of Mann-Whitney Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Places of Computer Access.

		Fear/Anxiety	Enthusiasm	Persistence	Indifference	Whole Scale
Home No (n = 147) Yes (n = 185)	Z	-1.509	-1.208	-0.131	-0.476	-1.869
	p	**0.131**	**0.227**	**0.896**	**0.634**	**0.062**
Friend's House No (n = 141) Yes (n = 190)	Z	-2.585	-1.217	-1.018	-1.035	-0.782
	p	**0.010***	**0.224**	**0.309**	**0.301**	**0.434**
Relative's House No (n = 146) Yes (n = 184)	Z	-2.821	-0.079	-0.718	-1.731	-1.548
	p	**0.005***	**0.937**	**0.473**	**0.083**	**0.122**
Primary School No (n = 202) Yes (n = 94)	Z	-0.933	-0.261	-0.641	-0.670	-0.988
	p	**0.351**	**0.794**	**0.521**	**0.503**	**0.323**
Secondary School No (n = 181) Yes (n = 144)	Z	-2.137	-1.159	-3.357	-1.074	-0.643
	p	**0.033#**	**0.246**	**0.001***	**0.283**	**0.520**

* Statistically significant at p < 0.01

TABLE 4–9: The Results of Kruskal-Wallis Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Social Conditions of Use.

		Fear/Anxiety	Enthusiasm	Persistence	Indifference	Whole Scale
Uses the computer alone	Chi-Square	15.807	13.250	6.327	4.088	20.135
	df	2	2	2	2	2
	p	**<0.0005***	**0.001***	**0.042#**	**0.130**	**<0.0005***
Uses the computer with friends	Chi-Square	6.208	0.737	0.193	0.875	4.744
	df	2	2	2	2	2
	p	**0.045#**	**0.692**	**0.908**	**0.646**	**0.093**
Uses the computer with family members	Chi-Square	3.162	1.202	0.006	2.069	4.090
	df	2	2	2	2	2
	p	**0.206**	**0.548**	**0.997**	**0.355**	**0.129**

* Statistically significant at p < 0.01

TABLE 4–10: The Results of Kruskal-Wallis Analyses of the Scores Obtained by Students on the Attitude Measures According to the Reported Frequency with which They used the Computer for Given Activities.

		Fear/Anxiety	Enthusiasm	Persistence	Indifference	Whole Scale
Plays games on computer	Chi-Square	8.776	10.038	1.334	3.013	7.718
	df	2	2	2	2	2
	p	**0.012#**	**0.007***	**0.513**	**0.222**	**0.021#**
Does schoolwork on computer	Chi-Square	5.837	0.925	1.976	3.728	5.831
	df	2	2	2	2	2
	p	**0.054**	**0.630**	**0.372**	**0.155**	**0.054**
Does homework on the computer	Chi-Square	10.448	2.475	9.912	3.660	9.009
	df	2	2	2	2	2
	p	**0.005***	**0.290**	**0.007***	**0.160**	**0.011#**
Uses the internet	Chi-Square	10.123	3.145	2.020	5.033	11.089
	df	2	2	2	2	2
	p	**0.006***	**0.208**	**0.364**	**0.081**	**0.004***
Does programming on the computer	Chi-Square	2.795	8.068	6.003	1.004	4.645
	df	2	2	2	2	2
	p	**0.247**	**0.018#**	**0.050#**	**0.605**	**0.098**
Draws and designs	Chi-Square	5.315	3.534	5.289	1.033	6.088
	df	2	2	2	2	2
	p	**0.070**	**0.171**	**0.071**	**0.597**	**0.048#**

* Statistically significant at $p < 0.01$

COMPUTER EXPERIENCE AND COMPUTER ATTITUDES

For this study, computer experience was examined in terms of access and frequency of use for popular activities. Tables 4-8, 4-9 and 4-10 contain the Mann-Whitney and Kruskal-Wallis results of the analyses of the scores on the attitude measures as they relate to access to computers and activities for which computers were used. An examination of these results revealed that students who reported that they used computers at a friend's or relative's house scored significantly higher on the Fear/Anxiety subscale, indicating that they were less fearful and anxious about computers than were those students without such access (Table 4-8).

It is tempting to suggest that working at a friend's or relative's house was associated with lower levels of anxiety because of the possibility of working with others. However, a closer examination showed no differences in the scores on the Fear/Anxiety subscale for students who reported using the computer with friends and relatives and those who did not (Table 9). Perhaps a better conjecture might be that those students who were less fearful and anxious were more likely to be allowed to use the computers of their friends and relatives. In Barbados, computer equipment is expensive, and computer owners might be reluctant to put their systems in the hands of anyone who they suspect might be less than confident and competent.

In addition, students who reported that they used computers at secondary school had a lower mean rank on the Persistence subscale, suggesting that they were less persistent with computer tasks than were those students who did not use computers at secondary school. According to Brosnan (1998), lack of persistence is a symptom of low self-efficacy which is itself a symptom of computer anxiety. However, for this sample, the students who reported using computers at secondary school did not score significantly higher on the Fear/Anxiety subscale than did those who reported that they did not. Thus, possible reasons for this finding are not clear.

Kruskal-Wallis tests were run to ascertain if the frequency with which students reported that they used computers for given activities was related to computer attitudes. These tests revealed that there were significant differences on the scores on the Enthusiasm subscale among students who reported playing games on the computer, on the scores on the Fear/Anxiety and Persistence subscale among those who reported doing homework on the computer, and on the scores on the Fear/Anxiety subscale among those who reported using the Internet (Table 4–10). Follow-up procedures (pairwise comparisons using Mann-Whitney tests) were carried to investigate where the differences were located.

The follow-up procedures indicated that students who reported that they played games often were more enthusiastic than those who reported playing games sometimes ($Z = -2.712$, $p = 0.007$) and those who said that they never played games ($Z = -2.598$, $p = 0.009$). It was also found that students who reported that they never did homework on computers were significantly more fearful and anxious than those who said that they sometimes used computers to do homework ($Z = -2.655$, $p = 0.008$). Surprisingly, those who said that they often did homework on computers appeared to be significantly more fearful and anxious than those who used computers only sometimes ($Z = -2.862$, $p = 0.004$). In addition those who often used computers for homework scored higher on the Persistence subscale than those who used them sometimes ($Z = -2.730$, $p = 0.006$) and those who never used them for this activity ($Z = -2.935$, $p = 0.003$). Finally, those who reported that they often used the Internet scored significantly higher on the persistence subscale than those who said that they never did this activity.

In order to find out whether using the computer alone or with others was related to computer attitudes for the sample, a series of Kruskal-Wallis tests was run. No significant differences were indicated on any of the attitude measures for students who reported using computers with friends and relatives (Table 4–9). However, the tests revealed that, students who said that they used computers alone with varying degrees of frequency had significantly different scores on the Fear/Anxiety and Enthusiasm subscales and on the whole attitude scale.

The results of pairwise follow-up Mann-Whitney tests showed that students who reported that they never used computers alone were significantly more fearful and anxious than those who reported that they sometimes used computers alone ($Z = -2.707$, $p = 0.007$) and those who reported that they often did so ($Z = -3.786$, $p < 0.0005$). There was also an indication that those who reported often using computers alone were more enthusiastic about computers than those using them alone sometimes ($Z = -3.392$, $p = 0.001$) and those who reported that they never used computer alone ($Z = -2.759$, $p = 0.006$). Finally, students who reported often using computers alone scores significantly higher on the whole attitude scale than those who reported using them alone sometimes ($Z = -3.303$, $p = 0.001$) and those who reported that they never used them alone ($Z = -4.712$, $p < 0.0005$).

In the study of Loyd and Gressard (1984a), computer experience was measured in terms of the length of time the respondents had been using computers. The findings indicated that students with more computer experience were less anxious, more confident and had greater liking for computers than did those with less experience. The results of the current study seem to be comparable, in that where significant differences were present on the various attitude measures, those students who reported more contact with computers seemed to possess the more favourable attitudes. It therefore seems that the more contact the students in the sample had with computers, the more likely they were to report positive attitudes toward computers.

It is noteworthy that some of the comparisons of the scores on the various attitude measures were significant at the less stringent 0.05 probability level (indicated by # in Tables 4-8, 4-9, and 4-10). Investigations revealed that in most of these cases, students who reported most contact with computers also had more positive scores. However there were a few anomalies. For example, one result indicated that students who reported sometimes using computers alone were significantly less persistent that those doing so often. However there were no significant differences on this measure between these two groups and those students who said that they never used computers alone. Such findings would require further investigation. It could perhaps be that working with others encourages some students to persist with computer tasks longer than if they were working alone.

STUDENTS PERCEPTIONS OF THE USEFULNESS OF COMPUTERS IN MATHEMATICS CLASSES

In order to find out the students' perceptions of the usefulness of computers in mathematics classes, they were asked to write in a paragraph whether or not they believed computers could help them in mathematics classes and to give reasons for their responses. Of the 235 students who provided a response, 183 (78%) of them felt that computers would be useful in mathematics classes, 40 (17%) said no and 12 (5%) seemed undecided. A variety of reasons were given in support of the positions taken.

For example, among those who said yes to computers in mathematics classes, there was the general feeling that they would make the subject easier. Some typical responses were:

> I think computers will help me in my schoolwork very well because it is much easier and I feel I would be helped to understand my work better. *(Girl, Form 4)*
>
> I would love to do a computer class in maths. It will help you a lot with not having to write. *(Girl, Form 1)*
>
> I (think) that it should be used in maths because you just have to press the numbers. You get through easy, finish early and you can check over for any mistakes. *(Girl, Form 1)*
>
> I think working with the computer is useful for maths and it would make work easier and you would not have to work so hard. *(Boy, Form 1)*
>
> I agree that they would greatly aid you in maths and (give) you quick solutions (e.g. graphs). *(Boy, Form 4)*
>
> Yes I feel the computer can help me to do maths because you would not have to write and it would be easy to do working and count and it would be fun. *(Boy, Form 4)*

Such responses suggested that these students might hold very naïve views about the capabilities of computers. There is almost a sense that these students expect a miraculous improvement in their mathematics abilities simply because computers are being used. To these students, mathematics seemed to be about getting right solutions to problems and computers might provide a means of doing so quickly.

Some students however recognized that using computers in their mathematics classes would not mean that they would only have to "press a number" and wait for the computer to deliver answers. This response from a fourth year girl summed up these views well when she wrote:

> I have no problem using a computer in mathematics because it would only be like a tool like a calculator, and I understand that it cannot think for you, it is only there to guide you and help you.

For these students, computers are merely another resource at their disposal to help them to learn mathematics, and many of them recognized that they would still need to think about the mathematics and make decisions for themselves.

Further, several students suggested that using computers in mathematics would be challenging, exciting and fun. Some complained that mathematics was a difficult and boring subject, but they believed that if computers were used, this could change:

> I think it's a great idea to introduce computers in school because it would help to encourage children to learn in school and to help children learn and have fun. *(Boy, Form 1)*

> I think we should use computers in mathematics to make it easier and more exciting for the students. Mathematics gets harder each term and year and the students find it difficult to learn it especially if it is boring and it usually is. *(Girl, Form 4)*

There was also a group of students who thought that computers would benefit slower students, and save others from embarrassment by not making them look foolish. Others expressed the view that being able to work at their own pace was also an advantage of using computers:

> I think working with a computer in maths would be really interesting for children that don't work fast and that don't understand. *(Girl, Form 1)*

> I could put a software program in the computer and be able to go at my own pace and it wouldn't make you feel bad and you wouldn't get fed up and mad …. *(Boy, Form4)*

> I can work alone with my computer and work out sums. It will help me with problems in maths and will help me to think better. The computer will not make me feel like a fool. *(Boy, Form 4)*

It is apparent from these responses that the students who had positive views about the use of computers in mathematics classes based these views on a wide range of reasons, going from the naïve "making maths easier" to an expectation of having another tool to use to having a safe environment in which to learn what they consider a difficult subject. There was a certain eager anticipation and enthusiasm for computers in mathematics classes. However, in many of these cases these feelings seemed to be based on an almost unrealistic expectation of what computers can do in mathematics classes.

Of great interest were the 40 students who did not think computers would be helpful in mathematics. In fact, many of these felt that using computers would make students mentally lazy, unable to think for themselves and totally dependent on the computers for even the smallest calculation. Some even felt that to use computers in mathematics amounted to cheating.

> Computers don't help you in maths because they always help you to [get] the answer for the question and that will make you lazy and take a lot of shortcuts (in the) future. *(Girl, Form 4)*

> I strongly feel that computers should not be associated with maths … If we as students rely on computers for our basic and everyday knowledge, when it comes to problem solving using the brain our brain cells would be so relaxed we would not have much knowledge about anything. Please do not allow computers to be used in Math. Thank you!!!! *(Girl, Form 4)*

> I don't agree to the use of computers in maths. Why? I feel by introducing it into maths it would encourage children not to think for themselves, thus would not know how to do things for themselves. *(Boy, Form 4)*

> No. I don't think that computers should be used in mathematics because you should be able to work out the problems yourself and not with the help of a computer because when you do a test you are not going to have computers, you are going to use your head. Although people think it might be easier, … it is not going to help you later in life because if somebody ask you a simple question you are not able to know because you are all caught up in the computer. I think that you should use your brains and do it yourself. Although I think that it's best you do not use the computer but it is still your decision. *(Girl, Form 1)*

> We should not use computers for maths because you would not have a brain for yourself. No I could never agree because you need to think for yourself. *(Boy, From 1)*

> It would not help you. It would be like cheating. It would help you a little but then it would be like cheating. *(Girl, Form 1)*

> No, I do not think computers should be used in the mathematical area. The use of computers in the area would certainly take away the whole meaning of the subject which is to make students think and reason. *(Boy, Form 4)*

None of these 40 students wrote anything to imply that they did not like computers or that they believed that they were bad. What came through their writings was that computers would be bad *for mathematics learning*. In fact, an examination of these students' scores on the attitude measures revealed that although some of them had low scores indicating negative attitudes toward computers, many had very high scores. This seems to suggest that these negative perceptions of computers in mathematics are not simply a reflection of overall negative attitudes to computers, what perhaps Galbraith and Baines (1998) referred to as low computer motivation. Evidently these students believe that using computers in mathematics could pose a threat to the very essence of what constitutes mathematics.

Overall, the perceptions of the students seemed to reflect many of the views expressed in the public debate carried on in the Barbadian news media about the use of computers in schools. But they may be linked to the students' views of what is mathematics. If they believe that mathematics is a set of rules and formulae to be used for finding right answers to problems (Skemp, 1976), then it is understandable why they might think that computers could do it all for them, since computers can be programmed to carry out these algorithms. It would also explain why those who oppose computers in mathematics might believe that the purpose of mathematics might be lost. However, if mathematics is seen as relationships between concepts and an exploration of why things work, then computers might be viewed as powerful tools for investigating these relationships.

If the students' views of mathematics influences their perception of the usefulness of computers in mathematics, then it seems vital that efforts must be made to redefine mathematics so that computers can be seen as tools with which they can come to a better understanding of some mathematical ideas. They should be helped to think of computers not only as means of exploring difficult concepts, but also as a means of sharing their understandings with others.

CHAPTER FIVE

CONCLUSION

This study was designed to investigate the computer attitudes of Barbadian secondary school students. Answers to the following research questions were sought:

- What attitudes do Barbadian students have toward computers?
- Are there gender-related differences in attitudes toward computers?
- Are there age-related differences in computer attitudes?
- Do students with different kinds of computer experiences have different attitudes toward computers?
- What are students' perceptions about the usefulness of computers in their mathematics classes?

Data were collected primarily by a self-report questionnaire, consisting of an attitude scale and demographic information, and a written paragraph from first and fourth form students in two secondary schools. A principal components factor analysis carried out on the data from the attitude scale yielded a four-factor solution using 27 of its 30 original items. These four factors were identified as Fear/Anxiety, Enthusiasm, Persistence and Indifference. These dimensions of computer attitude were used in the analyses of the data from the attitude scale. The paragraphs were examined for common themes that shed light on the predominant perceptions of mathematical applicability of computers. Analyses were also done on the data related to the computer experience of the students in the sample, since computer attitudes have been shown to be related to and affected by differential computer experience (Sutton, 1991, Kirkpatrick & Cuban, 1998; Brosnan, 1998).

Some interesting findings related to the computer experience of the students in the sample emerged. For example, in terms of places of access to computers, the boys and girls reported similar access, except in secondary school. Of specific interest is the lack of difference in home access to computers. This finding is different from those of other studies which reported gender–related differences in home access to computers, where boys were shown to have greater access (Harvey & Wilson, 1985; Kirkman, 1993). However, it lends support to the findings of Wilder, Mackie and Cooper (1985) and Harris (1999) who found that boys and girls in their samples reported very similar home access to computers.

While no definitive reasons for these differences in findings can be given here, a possible answer could lie in the parental beliefs about computers. For example, Hess and Miura (1985) pointed out that parents may focus on the link between computers and science and deem them more appropriate for boys than girls, and thus may be more inclined to purchase a home computer for their sons rather than their daughters. If parental attitudes influence home access to computers, then this could explain the lack of gender-related differences for this sample. In the Barbadian setting, there is the general perception that computer experience is necessary for advancement in the present and especially future society. It is possible that parents, recognizing the advantages for the future of their children, might make every effort to ensure that they have access to computers, regardless of their gender. In addition, even those children whose parents cannot afford to purchase a computer, may take the initiative to use a computer at a friend's or relative's house. Interestingly, no gender-related differences were found in access to computers at the homes of friends and relatives.

Another interesting finding relating to computer experience was that generally boys and girls in the sample reported similar frequency of use of the computer for all of the activities listed, except surfing the Internet. Many of the earlier studies found significant gender-related differences in use of computers, with boys tending to favour games and programming, while girls seemed to prefer wordprocessing (Lockheed, 1985; Hess & Miura, 1985). However, like the findings of Harris (1999), the patterns of use were similar for boys and girls in the sample. The difference in Internet use is puzzling should be the subject of further investigation. The Internet is beginning to feature quite often in educational applications of computers, and if negative feelings and attitudes are associated with its use, then the outcomes of such educational activities could be adversely affected.

Besides gender, age-related differences in computer use and access were also investigated among the sample of this study. The fact that younger students reported computer access in primary school more frequently than did the older students was not a total surprise, since as stated before, the older student would most likely have left primary school before computers had become fairly widespread in schools. Likewise it was no surprise when older students reported greater access in secondary school, because formal classes with computers are introduced in the fourth forms in Barbadian secondary schools. However, it is expected that this difference would disappear in a few years after computer integration has been practiced at all levels in Barbadian schools.

Wilder, Mackie and Cooper (1985) pointed to age-related differences in computer use when they suggested that younger students tended to use computer more for playing games and that older students tended to be involved in more formal instructional use. The findings of this study showed partial support for their findings. Although there were no significant age-related differences in the use of computers for activities that may be related to formal instruction (programming, homework, schoolwork, designing & drawing), the younger students in the sample reported playing games on the computer significantly more often than did older students. This could have an effect on the students' attitudes to computers, since as Wilder et al. pointed out, computer attitudes may become less positive when computers become the focus of school-based instruction instead of "agents of play and diversion" (p. 221).

The relationship between computer experience and computer attitudes suggests that gender- or age-related differences in experience might lead to differences in attitudes. The analyses of the data from the attitude scale provided interesting answers to the research questions. For example, no gender-related differences were found on the scale, nor on any of the four dimensions Fear/Anxiety, Enthusiasm, Persistence, and Indifference. This may be related to the previous finding of no differences in computer experiences among the boys and the girls, where similar computer experience seemed to be associated with similar attitudes among the girls and boys in the sample. Brosnan (1998) reported that research findings showed that girls were significantly more anxious about using computers than were boys. But he also pointed out that lower levels of anxiety were associated with frequent use of computers. The findings among this sample suggest that perhaps if boys and girls are allowed to have similar computer experiences, then differential gender-related computer attitudes could be reduced.

While they were no gender-related differences in computer attitudes among the sample, some age-related ones were registered. In fact, younger students were found to be significantly more fearful and anxious about using computers than were the older students. One possible reason for the lower level of anxiety among the older students could be the fact that they may be receiving formal instructions with computers and this may have led to increased confidence in using computers. On the other hand, though, the younger students were found to be more persistent with computer tasks. Linking this persistence to the playing of games seems reasonable, since there are usually coveted rewards for successfully achieving the goal of the game. Ironically, it could be that the same factor that led to increased confidence in the older students may also have contributed to their weakened persistence. Wilder *et al.* noted that associating computers with schoolwork could lead to less positive attitudes among some students. In fact, the data suggested that for some activities, the greater the amount of experience, the more positive the computer attitudes.

For example, those students whose computer experience involved playing games often were more enthusiastic about computers than the other students. Those who used computers often to do homework were more persistent than those who did not, while those who surfed the net often were less anxious and more positive about computers overall than were the other students. Interestingly, for several activities, the difference in attitudes between students with varying degrees of experience approached statistical significance. Generally when there was a significant difference in attitudes or even when the difference approached significance, the students with the most experience had the most positive attitudes. This finding seems to support Brosnan (1998) submission that positive computer attitudes can be fostered by increased exposure to computers. The implication then is that perhaps if students are given the opportunity to acquire a great amount of computer experience, then they could develop favourable computer attitudes.

The overall analyses of the data for the entire sample of students suggested that they were generally positive about computers. However, they were particularly enthusiastic about using computers. If the positive influence of experience is accepted, then it is not surprising that such enthusiasm for computers is present, for indeed, the students in the sample seemed to have had exposure to computers. No doubt, the quality of the exposure to computers could have a profound influence on attitudes. It would therefore be of interest to monitor the initial experiences that the students have with computers as they are introduced into the different subject area and ascertain the effects on their computer attitudes.

The influence that computer use and computer attitudes seem to have on each other may be linked to the students' perceptions of computers in mathematics classes. Education authorities are expecting positive outcomes when computers are integrated into these classes. However, Johnston (1987) and Brosnan (1998) contended that adverse computer attitudes could inhibit learning. Hence prior knowledge about the types of attitudes that students are likely to have toward the use of computers in given subject areas would be extremely valuable. The findings of this study suggested that the students in the sample had a wide range of views about the usefulness of computers in mathematics classes. These perceptions were related to the ability of computers to make mathematics fun, easy, and interesting, as well as to the computer as a tool that would promote mental laziness and dependence. A few students acknowledged that computers were potentially powerful tools with which to learn mathematics. If the contentions of Johnston and Brosnan are accepted, then it seems possible that some of these students might resist using computers in mathematics and teachers would need to have appropriate skill to overcome this resistance and allow these students to receive maximum benefit from their use of computers in mathematics.

It must be borne in mind, that the sample of students about which these statements are made were not selected by probability methods and therefore it would not be appropriate to generalize these findings beyond this group. However, the information gathered from this study offers insights into the types of attitudes that Barbadian students are likely to have toward computers, and provides a foundation upon which further research can be based.

IMPLICATIONS FOR FURTHER RESEARCH

The positive attitudes toward computers held by the students in the sample seem to be based on past experience. However, their perceptions and expectations of the use of computers in mathematics seem to be based primarily on the information available by means of the media. This is however not unexpected since computers have not been integrated across the curriculum in Barbadian schools in the manner that this innovation demands. Although some students are skeptical, the optimism that most of the students possess raises several questions that would need to be investigated. For example, how will students' positive attitudes be affected if the reality of using computers in their classes does not live up to their expectations? Also, are there ways that computers can be effectively used to maintain positive attitudes and allay the anxieties that some may feel? In addition, it would be of interest to ascertain to what extent students' attitudes toward computers in general are transferred to subject content (mathematics) that they study using computers? Answers to these questions will be explored in a larger scaled study that will be conducted to ascertain the initial impact of computers on education in Barbados.

Another related area that will be explored is the attitudes that teachers may hold toward computers and the consequences of these for student attitudes and teaching and learning with the assistance of computers. It seems reasonable to assume that just as students' computer attitudes may have an effect on their interactions with them, the same may also be true for teachers. Research has shown that teachers' attitudes toward computers as well as their competence in using them to deliver curriculum material can be of vital importance to the outcomes of computer integration programmes (Hannaford, 1988; Zammit, 1992; Chrisostomou & Banks, 1999). Availability of computers and access to them are also influential variables that can dictate how computers are used (Andrews, 1997).

These factors can have a profound effect on how both teachers and students use computers for the teaching and learning of mathematics, with implications for student achievement. If teachers and students are so overwhelmed by the technology, or so excited by it, that it, rather than the subject content, becomes the focus of classroom activity, then the purpose of the technology as a tool would be lost. In addition, if the computers are inaccessible, teachers may be deterred from using them and may lose the opportunity to make powerful mathematical points to the students. Thus, the follow-up study will seek to ascertain how these factors interact and the influence that they have on the learning outcomes when computers are integrated into the curriculum in the Barbadian context.

These considerations suggest that the research into the use of computers must go beyond a study of students' computer attitudes. The other factors that can have an impact on the students' academic and social growth also need to be examined. It is therefore this researcher's intention to investigate the areas in the Barbadian setting:

- Students' computer attitudes on a larger more representative scale;
- Teachers' attitudes toward computers and their use in the classroom;
- Teachers' competence in using computers in the classroom;
- Factors that facilitate or hinder the use of computers in the schools' curricula; and
- The attitudinal, academic and social outcomes of using computers in classrooms.

It is the researcher's belief that answers to these questions can provide valuable insights into the effects of the use of computers on education in small developing countries like Barbados.

REFERENCES

Ajzen, I. & Fishbein, M. (1980). ***Understanding attitudes and predicting social behaviour.*** Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. (1988). ***Attitudes, personality and behaviour.*** Milton Keynes, UK: Open University Press.

Allport, G. W. (1967). Attitudes. In M. Fishbein (Ed.), ***Readings in attitude theory and measurement.*** (pp. 1-13) . NY: John Wiley.

Andrews, P. (1997). Secondary teachers' perceptions of computer availability: A qualitative study. ***Journal of Information Technology for Teacher Education, 6,*** 321- 337.

Bagozzi, R. P. & Burnkrant, R. E. (1979). Attitude organization and the attitude - behaviour relationship. ***Journal of Personality and Social Psychology, 37,*** 913 - 929.

Bagozzi, R. P. & Burnkrant, R. E. (1985). Attitude organization and the attitude - behaviour relationship: A reply to Dillon and Kumar. ***Journal of Personality and Social Psychology, 49,*** 47 - 57.

Baines, L. (1997). Future schlock: Using fabricated data and politically correct platitudes in the name of education reform. ***Phi Delta Kappan, 78,*** 492 - 498.

Ball, D. (1987a). Microcomputers in mathematics teaching. ***British Journal of Educational Technology, 18,*** 247 - 255.

Ball, D. (1987b). PROLOG and mathematics teaching. ***Educational Review, 39,*** 155 - 161.

Barba, R. H. (1991). Assessing American children's attitudes towards computer technology. ***International Journal of Mathematical Education in Science and Technology, 22,*** 731 - 737.

Becker, H. J. (1984). Computers in schools today: Some basic considerations. ***American Journal of Education, 93,*** 22 - 39.

Bell, J. (1993). ***Doing your research project: A guide for first-time researchers in education and social science (2nd ed.).*** Milton Keynes, UK: Open University Press.

Brace, N., Kemp, R. & Snelgar, R. (2000). ***SPSS for psychologists: A guide to data analysis using SPSS for Windows.*** London, UK: Macmillan Press.

Brecker, S. J. (1984). Empirical validation of affect, behaviour, and cognition as distinct components of attitude. ***Journal of Personality and Social Psychology, 47,*** 1191 - 1205.

Brosnan, M. (1998). ***Technophobia: The psychological impact of information technology.*** London, UK: Routledge.

Brownell, G. (1992). ***Computers and teaching (2nd ed.).*** St. Paul, MN: West.

Burns, R. B. (2000). ***Introduction to research methods.*** London, UK: SAGE.

Carr, W. & Kemmis, S. (1986). ***Becoming critical: Education, knowledge and action research.*** London, UK: Deakin University Press.

Chrisostomou, C. & Banks, F. (1999). ***Primary teachers' attitude to the use of ICT: A comparative study between Cyprus and the UK.*** (http;//www.leeds.ac.uk/educol/documents/00001300.htm.)

Cohen, L. & Manion, L. (1994). ***Research methods in education (4th ed.).*** London, UK: Routledge.

Dillon, W. R. & Kumar, A. (1985). Attitude organization and the attitude - behaviour relationship: A critique of Bagozzi and Burnkrant's reanalysis of Fishbein and Ajzen. ***Journal f Personality and Social Psychology, 49,*** 33 - 46.

Festinger, L. (1957). ***A theory of cognitive dissonance.*** Evanston, IL: Row, Peterson.

Fishbein, M. (1967). Attitude and the prediction of behaviour. In M. Fishbein (Ed.). ***Readings in attitude theory and measurement.*** (pp. 477–492). New York: John Wiley & Sons.

Galbraith, P. & Haines, C. (1998). Disentangling the nexus: Attitudes to mathematics and technology in a computer learning environment. ***Educational Studies in Mathematics, 36,*** 275 - 290.

Gall, M. D., Borg, W. R. & Gall, J. P. (1996). ***Educational research (6th ed).*** White Plains, NY: Longman.

Gay, L. R. (1996). ***Educational research: Competencies for analysis and application (5th ed).*** Upper Saddlr River, NJ: Prentice-Hall.

Green, B. F. (1954). Attitude measurement. In G. Lindzey (Ed.). ***Handbook of Social Psychology: Theory and method*** (pp. 335-369). MA: Addison- Wesley.

Guba, E. G. & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.). ***Handbook of qualitative research*** (pp. 105 – 117). London, UK: SAGE.

Hannaford, M. E. (1988). ***Teacher attitudes toward computer use in the classroom.*** Seattle, WA: ERIC Document Reproduction Service No.ED 296 721.

Harris, S. (1999). Secondary school students' use of computers at home. ***British Journal of Educational Technology, 30,*** 331 - 339.

Harvey, T. J. & Wilson, B. (1985). Gender differences in attitudes towards microcomputers shown by primary and secondary school pupils. ***British Journal of Educational Technology, 16,*** 183 - 187.

Hativa, N. (1988). Computer-based drill and practice in arithmetic: Widening the gap between high- and low-achieving students. ***American Educational Research Journal, 25,*** 366 - 397.

Hawkins, J. (1985). Computers and girls: Rethinking the issues. ***Sex Roles, 13,*** 165 - 180.

Hess, R. D. & Miura, I. T. (1985). Gender differences in enrollment in computer camps and classes. ***Sex Roles, 13,*** 193 - 203.

Howe, J.A.M. & du Boulay, B. (1979). Microcomputer assisted learning: Turning the clock back? ***Programmed Learning and Educational Technology, 16,*** 240 - 246.

Hudson, B. & Borba, M. (1999). The role of technology in the mathematics classroom. ***Micromath, 15,*** 19 - 23.

Huff, C. & Cooper, J. (1987). Sex bias in educational software: The effect of designers' stereotypes on the software they design. ***Journal of Applied Social Psychology, 17,*** 519 - 532.

Johnston, V. M. (1987). Attitudes towards microcomputers in learning: Pupils and software for language development. ***Educational Research, 29,*** 47 - 55.

Kinnear, A. (1995). Introduction of microcomputers: A case study of patterns of use and children's perceptions. ***Journal of Educational Computing Research, 13,*** 27 - 40.

Kirkman, C. (1993). Computer experience and attitudes of 12-year-old students: Implications for the UK National Curriculum. ***Journal of Computer Assisted Learning, 9,*** 51 - 62.

Kirkpatrick, H. & Cuban, L. (1998). Should we be worried? What the research says about gender differences in access, use, attitudes, and achievement with computers. ***Educational Technology, 38,*** 56 - 61.

Kosakowski, J. (1998). ***The benefits of information technology.*** Syracuse, NY: ERIC Clearinghouse on Information and Technology. (ERIC Digest ED 420 302).

Linn, M. C. (1985). Fostering equitable consequences from computer learning environments. ***Sex Roles, 13,*** 229 - 240.

Lockheed, M. E. (1985). Women, girls, and computers: A first look at the evidence. ***Sex Roles, 13,*** 115 - 122.

Loyd, B. H. & Gressard, C. (1984a). ***The effects of sex, age, and computer experience on computer attitudes***. ERIC Document Reproduction Service No. ED 246 878.

Loyd, B. & Gressard, C. (1984b). Reliability and factorial validity of computer attitude scales. ***Educational and Psychological Measurement, 44,*** 501 - 555.

MacNab, D. & Fitzsimmons, G. (1999). Enhancing math learning through computer-assisted instruction. ***Education Canada, 39,*** 38 - 39.

Maddux, C. D. (1988). Preface to 'Assessing the impact of computer-based instruction: a review of recent research'. ***Computers in the Schools, 5,*** 8.

Martin, R. (1991). School children's attitudes towards computer as a function of gender, course subjects and availability of home computers. ***Journal of Computer Assisted Learning, 7,*** 178 - 194.

Mevarech, Z. R. & Kapa, E. (1996). The effects of a problem-solving based Logo environment on children's information processing components. ***British Journal of Educational Psychology, 66,*** 181 - 195.

Mevarech, Z. R. & Kramarski, B. (1993). Vygotsky and Papert:social-cognitive interactions within Logo environments. ***British Journal of Educational Psychology, 63,*** 96 - 109.

Mevarech, Z., Shir, N. & Movshovitz-Hadar, N. (1992). Is more always better? The separate and combined effects of a computer and video programme on mathematics learning. ***British Journal of Educational Psychology, 62,*** 106 - 116.

Miles, M. B. & Huberman, A. M. (1994). ***Qualitative data analysis: An expanded sourcebook (2nd ed.).*** Thousand Oaks, CA: SAGE.

Ministry of Education, Youth Affairs & Culture (1995). ***White paper on education reform: Preparing for the twenty-first century*.** Barbados: Ministry of Education, Youth Affairs & Culture.

Ministry of Education, Youth Affairs & Culture (1997). ***EduTech 2000: Master plan for the integration of information technology into the school system***. Barbados: Ministry of Education, Youth Affairs & Culture.

Moore, A. (1993). Siuli's maths lesson: Autonomy or control? In J. Beynon & H. Mackay (Eds.). ***Computers into classrooms: More questions than answers*** (pp. 26 – 38). London: Falmer Press.

National Council for Educational Technology (1996). Integrated learning systems. ***Computer Education, 84,*** 17 - 20.

Nelson, L. R. (1988). Attitudes of Western Australian students towards microcomputers. ***British Journal of Educational Technology, 19,*** 53 - 57.

North, R. (1991). Managing the integration of information technology across the curriculum of the secondary school. ***Computers and Education, 16,*** 13 - 16.

Okebukola, P. A. & Woda, A. B. (1993). The gender factor in computer anxiety and interest among some Australian high school students. ***Educational Research, 35,*** 181 - 189.

Papert, S. (1980). ***Mindstorms: Children, computers and powerful ideas.*** Sussex, UK: Harvester Press.

Papert, S. (1993). ***The children's machine: Rethinking school in the age of the computer.*** New York: Harvester Wheatsheaf.

Pelgrum, W. J. & Plomp, Tj. (1991). ***The use of computers in education worldwide: Results from the IEA Computers in Education survey in 19 education systems.*** Oxford: Pergamon Press.

Pelgrum, W. J. & Plomp, Tj. (1993). The worldwide use of computers: A description of main trends. ***Computers and Education, 20,*** 323 - 332.

Postman, N. (1995). ***The end of education: Redefining the value of school*.** New York: Alfred A. Knopf.

Ransley, W. (1991). An instrument for measuring five aspects of childrens's attitudes towards microcomputers. ***British Journal of Education Technology, 22,*** 216 - 221.

Reece, M. J. & Gable, R. K. (1982). The development and validation of a measure of general attitudes toward computers. ***Educational and Psychological Measurement, 42,*** 913 - 916.

Reeves, T. C. (1998). Future schlock, the computer delusion and the end of education: Responding to critics of educational technology. ***Educational Technology, 38,*** 49 - 53.

Robson, C. (1993). ***Real world research: A resource for social scientists and practitioner-researchers.*** Oxford, UK: Blackwell Publishers.

Said, A. M. (1993). The effectiveness of using a pre-prepared electronic spreadsheet and the students' attitudes towards its use in mathematics tutorial classes. ***Computer Education, 75,*** 6 - 9.

Siegel, S. & Castellan, N. J. (1988). ***Nonparametric statistics for the behavioral sciences (2nd ed.).*** New York: McGraw-Hill.

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

Subhi, T. (1999). The impact of LOGO on gifted children's achievement and creativity. ***Journal of Computer Assisted Learning, 15,*** 98 - 108.

Sutton, R.E. (1991). Equity and computers in the schools: A decade of research. ***Review of Educational Research, 61,*** 475 - 503.

Tanner, H. (1992). Developing the use of IT within mathematics through action research. ***Computers and Education, 18,*** 143 - 148.

Thompson, N. (1991). Computers, curriculum and the learning environment. ***Computers and Education, 16,*** 1 - 5.

Tuckman, B. W. (1994). ***Conducting educational research (4th ed.).*** Orlando, FL: Harcourt Brace & Company.

van Weering, B. & Plomp, Tj. (1991). Information literacy in secondary education in the Netherlands: The new curriculum. ***Computers and Education, 16,*** 17 - 21.

Ware, M. C. & Stuck, M. F. (1985). Sex-role messages viv-a-vis microcomputer use: A look at the patterns. ***Sex Roles, 13,*** 205 - 214.

Welle-Strand, A. (1991). Evaluation of the Norwegian program of action: The impact of computers in the classroom and how schools learn. ***Computers and Education, 16,*** 29 - 35.

West, T. (1998). Integrated learning systems. ***Micromath, 14,*** 33 - 34.

Wiersma, W. (1995). ***Research methods in education: An introduction (6th ed).*** Needham Heights, MA: Simon and Schuster Co.

Wilder, G., Mackie, D. & Cooper, J. (1985). Gender and computers: Two surveys of computer-related attitudes. ***Sex Roles, 13,*** 215 - 228.

Woodrow, J.E.J. (1991). A comparison of four computer attitude scales. ***Journal of Educational Computing Research, 7,*** 165 - 187.

Zammit, S. A. (1992). Factors facilitating or hindering the use of computers in schools. ***Educational Research, 34,*** 57 - 66.

APPENDIX 1: The Statements on the Computer Attitude Scale (Loyd & Gressard, 1984)

Computer Anxiety

1. Computers do not scare me at all.
2. Working with a computer would make me very nervous.
3. I do not feel threatened when others talk about computers.
4. I feel aggressive and hostile toward computers.
5. It wouldn't bother me at all to take computer courses.
6. Computers make me feel uncomfortable.
7. I would feel at ease in a computer class.
8. I get a sinking feeling when I think of trying to use a computer.
9. I would feel comfortable working with a computer.
10. Computers make me feel uneasy and confused.

Computer Confidence

1. I'm no good with computers.
2. Generally, I would feel OK about trying a new problem on the computer.
3. I don't think I would do advanced computer work.
4. I am sure I could do work with computers.
5. I'm not the type to do well with computers.
6. I am sure I could learn a computer language.
7. I think using a computer would be very hard for me.
8. I could get good grades in computer courses.
9. I do not think I could handle a computer course.
10. I have a lot of self-confidence when it comes to working with computers.

Computer Liking

1. I would like working with computers.
2. The challenge of solving problems with computers does not appeal to me.
3. I think working with computers would be enjoyable and stimulating.
4. Figuring out computer problems does not appeal to me.
5. When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have an answer.
6. I don't understand how some people can spend so much time working with computers and seem to enjoy it.
7. Once I start to work with the computers, I would find it hard to stop.
8. I will do as little work with computers as possible.
9. If a problem is left unsolved in a computer case, I would continue to think about it afterward.
10. I do not enjoy talking with others about computers.

APPENDIX 2: Questionnaire Used for Data Collection in the Study

HOW DO YOU FEEL?

INSTRUCTIONS

This instrument has two (2) parts. The first part has a few questions about you. The second part has thirty (30) short statements expressing feelings about computers and using them. Please complete the questionnaire by answering ALL of the items. THANK YOU.

ABOUT YOU

Please complete the following items. Most of them require you to tick (✓) a box to show the answer that fits YOU best.

1. What form are you in? ______ 2. Your gender: ☐ FEMALE ☐ MALE

3. Which of these activities do you do on the computer?

ACTIVITIES	NEVER	SOMETIMES	OFTEN
Play games	☐	☐	☐
Do schoolwork	☐	☐	☐
Do homework	☐	☐	☐
Use the internet	☐	☐	☐
Write programmes	☐	☐	☐
Draw and designing	☐	☐	☐
OTHER (Please state):	☐	☐	☐
	☐	☐	☐

4. In which of these places have you used a computer?

ACTIVITIES	YES	NO
At home	☐	☐
At a friend’s house	☐	☐
At a relative’s house	☐	☐
At primary school	☐	☐
At secondary school	☐	☐
OTHER (Please write where): ______________________	☐	☐

5. Please indicate how often you use the computer under the following conditions.

CONDITIONS	NEVER	SOMETIMES	OFTEN
Alone	☐	☐	☐
With friends	☐	☐	☐
With family members	☐	☐	☐
With others (Please write): _______________	☐	☐	☐

Read each statement carefully and tick (✓) the box that shows how much you agree with it.

SA = Strongly Agree; A = Agree; U = Unsure; D = Disagree; SD = Strongly Disagree

	SA	**A**	**U**	**D**	**SD**
1. Computers do not scare me at all.					
2. Computers make me feel uncomfortable.					
3. Computers make me feel uneasy and confused.					
4. Figuring out computer problems does not appeal to me.					
5. Generally, I would feel OK about trying a new problem on the computer.					
6. I am sure I could do work with computers.					
7. I am sure I could learn a computer language.					
8. I could get good grades in computer courses.					
9. I do not enjoy talking with others about computers.					
10. I do not feel threatened when others talk about computers.					
11. I do not think I could handle a computer course.					
12. I don't think I would do advanced computer work.					
13. I don't understand how some people can spend so much time working with computers and seem to enjoy it.					
14. I feel aggressive and hostile toward computers.					
15. I get an anxious feeling when I think of trying to use a computer.					
16. I have a lot of self-confidence when it comes to working with computers.					
17. I think using a computer would be very hard for me.					
18. I think working with computers would be enjoyable and stimulating.					
19. I will do as little work with computers as possible.					
20. I would feel at ease in a computer class.					
21. I would feel comfortable working with a computer.					
22. I would like working with computers.					
23. I'm no good with computers.					
24. I'm not the type to do well with computers.					
25. If a problem is left unsolved in a computer case, I would continue to think about it afterward.					
26. It wouldn't bother me at all to take computer courses.					
27. Once I start to work with the computers, I would find it hard to stop.					
28. The challenge of solving problems with computers does not appeal to me.					
29. When there is a problem with a computer program that I can't immediately solve, I would stick with it until I have an answer.					
30. Working with a computer would make me very nervous.					

APPENDIX 3: The Topic for the Paragraph

TOPIC FOR PARAGRAPH ABOUT THE USE OF COMPUTERS IN MATHEMATICS

Imagine that you are in a mathematics lesson with a computer in front of you to help you.

In a paragraph, write how you feel about using computers in mathematics lessons. Do you think computers can be helpful for learning mathematics? If so, how? If not, why?

Please write your response at the back of the questionnaire

APPENDIX 4: The Cover Letter that was Read to the Participants of the Study

TO BE READ TO STUDENTS WHOSE ASSISTANCE IS BEING SOLICITED FOR THE RESEARCH PROJECT

Dear Students

I am trying to find out how you feel about computers and using them in your lessons.

Very soon you will be required to use computers in all your subjects, for homework and other activities.

I hope that finding out how you feel about computers will provide valuable information that can help your teachers and parents to understand what they can do to help you to make the best use of the computers. I am therefore requesting your assistance with this project.

You do not have to write your names on the questionnaires that will be handed to you. I will not show them to anyone. However, anyone who does not want to participate can be excused, but I hope that all of you will help me.

You will be required to read some statements and tick boxes to show your answers. You will also be required to write a very short paragraph.

It is NOT a test, so there are no right or wrong answers. Just make your feelings known.

Thank you for your assistance.

C. J. Leacock

APPENDIX 5: The Interview Schedule that was Piloted

INTERVIEW SCHEDULE
FOR PILOT INTERVIEWS

A. *KNOWLEDGE OF COMPUTERS*

Tell me what you know about computers.

What are some places where computers are used?

B. ACCESS AND USE

1. Do you own a computer? (Or have access to one that belongs to someone else?)
2. What do you use the computer for?
3. How often do you use a computer?

C. FEELINGS ABOUT COMPUTERS

1. How do you feel about computers?
2. *What do you like to do (best / least) on the computer?*
3. What do you like about the computer?
4. What do you dislike about the computer?

D. FEELINGS ABOUT COMPUTERS IN SCHOOL

1. What do you think computers could be used for in schools?
2. Would you like to spend more time on the computer in school? (Why /why not?)
3. Many say computers can help children to learn. What do you think?
4. Do you think the computer can help you to learn mathematics? (How / why not?)
5. Who do you think the computer would help most in mathematics classes?
   Weaker / faster students? Boys / girls? Younger / older students? (Why?)
6. Do you play (mathematical) games on the computer?
7. Do you think such activities would be useful in mathematics lessons?