AN INVESTIGATION INTO THE POSSIBLE CAUSES OF THE DIFFERENCE BETWEEN THE BOYS' AND GIRLS' DROP-OUT RATE IN MATHEMATICS AT THE END OF THE JUNIOR SECONDARY PHASE OF EDUCATION. (THE SURVEY WAS CONDUCTED ON ENGLISH-SPEAKING PUPILS IN SOME URBAN HIGH SCHOOLS OF THE MIDDLE AND UPPER SOCIO-ECONOMIC GROUP).

A dissertation submitted in part-fulfilment of the requirements of the M.Ed. degree of Rhodes University Grahamstown.

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C O N T E N T S

INTRODUCTION

In the past two decades much research in the field of Mathematics in Education has dealt with boy-girl differences. In the 1960's sex differences in mathematical achievement played an important role in research. The results of more recent and better controlled studies seem to indicate that overall boy-girl differences in mathematical achievement are probably negligible at the Primary stage and exist at the Secondary stage principally in areas involving spatial visualization and problem solving.

There has been an increasing concern about the fact that fewer girls than boys elect to continue studying mathematics when it becomes an optional subject. This concern has naturally focussed research on sex-differences in the drop-out rate in Mathematics.

Most of the research in this field has been conducted in the U.S.A. where numerous intervention programmes are underway which aim to reduce "mathematics anxiety" (especially in girls) and to increase the percentage of girls taking further courses in Mathematics.

My interest in the boy-girl drop-out rate was aroused by an article (Noble, 1974) written by Professor Noble of Rhodes University, Grahamstown. In his article, he describes a cross-sectional research project which he undertook in the White English-medium schools in Grahamstown in 1968. The aim of his study was not to investigate the drop-out rate but rather to correlate the attitudes to and abilities in Mathematics of boys and girls in the sample schools. He includes, however, in his research report, a graph which clearly depicts the difference in the drop-out rate between boys and girls. He attributes the general drop-out rate to a variety of factors, including lack of ability and unfavourable attitudes. He says that

> "It seems reasonable to assume that an unfavourable attitude towards Mathematics is also involved and that this is exhibited to a greater degree by the girls than the boys."
>
> (Noble, 1974. p 272)

The aim of my investigation is

(i) to determine the present extent of the difference in the drop-out rate in Mathematics between white English-speaking boys and girls at the end of Standard 7 in five East London High Schools.

(ii) to conduct an attitude survey with Standard 6 and Standard 7 pupils in order to determine whether there are differences in attitudes toward Mathematics between boys and girls which could influence their decisions about whether or not to take Mathematics in Standards 8, 9 and 10.

(iii) to examine previous research in an attempt to isolate factors which could affect the drop-out rate differentially.

The study revealed that the differences in the drop-out rate between boys and girls in each of Standards 8, 9 and 10 were very significant. The attitude survey indicated that girls have more adverse attitudes toward Mathematics than boys in Standard 7 but not in Standard 6. It also appeared that whereas the boys' attitudes do not differ much from Standard 6 to Standard 7, the Standard 7 girls were found to have less favourable attitudes toward Mathematics than the Standard 6 girls.

CHAPTER 1.

THE PRESENT POSITION.

There has been a growing awareness during recent years of the problem of under-representation by girls in Mathematics classes. Judith E. Jacobs referring to the situation in the United States writes

> "The low rate of participation of girls and women in the study of mathematics has become a national issue of great concern."
> (Jacobs, 1978 p 5.)

Although there has always been a disproportionate representation of girls and women in the field of mathematics, it has only really been thought of as a "problem" in the last couple of decades when women became aware of the possibilities of entering non-traditional occupations. Because of the awareness of career options in mathematics, science and engineering, women are realizing the importance of a solid grounding in mathematics.

Ruth Afflack in an article entitled "Mathephobia" says:

> "With the recent trend toward a more technological society many academic disciplines are requiring more mathematics. Computers are being used in such areas as History and English.

> Libraries are being re-organized through computers. Social and behavioural science fields are incorporating statistics as prerequisites for their courses. It is becoming more difficult for persons uncomfortable with mathematics to survive in society today." (Jacobs, 1978. p 73.)

Although women are realizing the importance of continuing their mathematics studies throughout their schooling, the fact remains that almost universally more boys than girls continue to study mathematics after it has become optional.

The disparity between boys and girls in enrolment in Mathematics courses is very evident in the United States where mathematics is optional after grade 8 (approx. age 13). More research has been conducted in the U.S.A. on sex-differences in the drop-out rate than in Britain or elsewhere in the world. In the U.S.A. at Junior High School level the number of boys and girls enrolled in Algebra 1 classes is about the same. By the time they reach their senior year, the ratio of males to females in advanced mathematics courses approaches three to one. By the third semester of College, the male/female ratio in mathematics courses is six to one. (Fennema and Sherman, 1976). Unfortunately no evidence is given concerning the enrolment in Geometry courses as this position could well be worse.

In 1972 the sociologist Lucy Sells conducted a survey of the students entering the University of California, Berkeley. She found that 57% of the men against only 8% of the women had taken the necessary high school mathematics to major in areas outside education and the helping professions.
(Jacobs, 1978)

In another study conducted by Fennema, it was found that not only were more boys enrolled in Mathematics classes in the four public schools involved, but more boys studied mathematics for four years in high school. In all four schools, the percentage of males enrolled in a third and fourth year of mathematics study was higher than the percentage of females. The difference was greatest in the fourth year Mathematics courses. (Fennema and Sherman, 1977)

Konsin, in a study of the enrolment in Wisconsin High School mathematics classes by sex, found a similar situation. (Konsin, M.A. 1977)

The Minneapolis Public Schools research department produced a report on enrolment in High School Mathematics courses by sex and race during the second trimester of the 1975-1976 school year. The information they obtained helped to direct the target efforts aimed at improving the status quo.
The eighth grade was identified as the most critical year because it was during that year that the pupils had to de-

cide whether or not to take Algebra in the Ninth Grade. A "Math Bridge" programme was implemented at the Eighth Grade level to bridge the gap between Junior High School and Senior High School. The programmes included motivational mathematical topics as well as programmes which stressed the importance of Mathematics to their futures. The table which follows shows the percentages of females in various High School Mathematics courses in the Winter trimester of 1976 and then of the same trimester in 1981. It can be seen that there was an improvement in the percentage of females enrolled in calculus and mathematical analysis. Ross-Taylor attributes some of the improvements to the intervention efforts like the "Math Bridge" programme, while some of it is probably a result of general changes in society with respect to roles of women and the difficult employment situation. (Ross-Taylor, B. 1983).
Nevertheless it should be noted that Geometry and Algebra did not show corresponding increases.

Percentages of Females enrolled in Mathematics Classes in the Minneapolis Public Schools in 1976 and 1981.

	1976	1981
Geometry	50%	50%
Algebra	47%	47%
Math. Analysis	35%	43%
Calculus	25%	43%

(Ross-Taylor, 1983. p 12)

Thomas L. Hilton and Gosta W. Berglund made use of longitudinal data from the Growth Study begun at the Educational Testing Service in 1961. They too found that at the High School level, boys enrolled in more mathematics courses than did the girls. (Hilton and Berglund, 1974)

Summarizing the situation in the U.S.A., Schonberger has the following to say:

> "... as of 1979 there seemed to be a few differences in performance in favour of males, which may be localized to certain schools or may be specific to mathematical tasks at higher cognitive levels. There are however, still substantial differences in participation in mathematics courses."
>
> (Lindquist, M., 1980. p 189)

The situation in Britain is roughly comparable to that in the U.S.A. but in Britain girls must continue their mathematical studies throughout their compulsory schooling. Almost all girls as well as boys study mathematics up to the age of sixteen but girls are inclined to drop out of mathematics-related study as soon as they have a choice.
The proportion of entries for public examinations in Mathematics by girls decreases as the level of examination increases. The report of the Committee of Inquiry into the teaching of Mathematics in Schools in Britain revealed that whereas almost equal numbers of boys and girls enter for the examination at C.S.E. level, in O-level Mathematics only 44% of the 1979 entry was from girls, while in A-level the percentage of girls dropped to 26% of the 1979 entry. A smaller proportion of girls then boys enter for O-level mathematics and a smaller proportion of girls than boys proceed to A-level. The result of this was that in 1979 nearly three times as many boys as girls entered the A-level mathematics.
This problem is also reflected in the teaching profession where in 1978 among 258811 women teachers and 180060 men teachers in maintained schools, there were 2484 women mathematics teachers and 5264 men mathematics graduates.
(Cockcroft, W.H., 1982.)

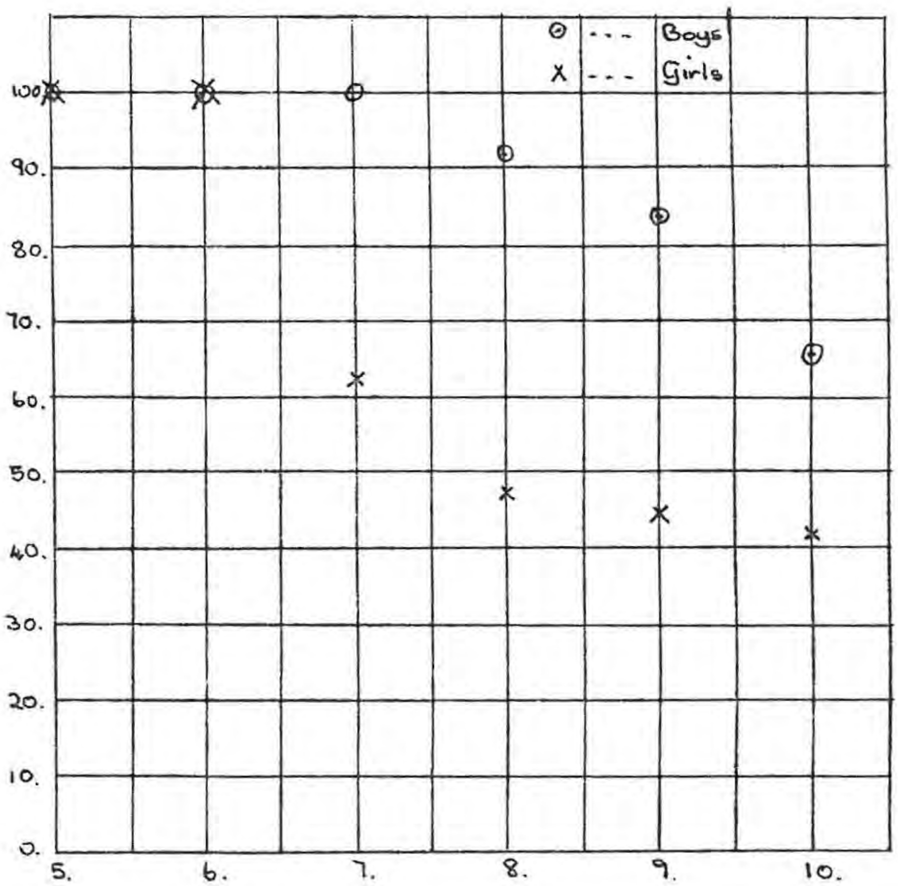
In South Africa, the situation is much the same as that in

Britain and the U.S.A.

South African children in White schools have to study Mathematics to the end of Standard 7 (approx. 13 years of age) after which it becomes optional.

Noble in his research project (Noble, 1974) involving white English-speaking scholars in Grahamstown, found a substantial difference in the drop-out rate between boys and girls after Standard 6 after which, at that time, it became optional. The results can be seen in the following figure:

Percentage taking Mathematics or Arithmetic



School Standard

In the Transvaal during 1980, 72% of schoolboys as against 48% of schoolgirls took Standard 10 mathematics. The situation is causing concern and the H.S.R.C. was to conduct a comprehensive study during 1983 at Transvaal schools to look at factors influencing mathematics achievement and participation. One of the questions assigned for investigation was "Why do a large proportion of girls elect to terminate their mathematics studies?" (Visser, D., 1983)

The data for the present cross-sectional study was obtained in 1983 from five high schools in East London. From the information gathered, it was possible to determine the drop-out rate in Mathematics in Standards 8, 9 and 10 for boys and girls separately. The percentages of boys and girls taking Mathematics in each standard as well as the percentage difference between boys and girls can be seen in the Table below. From the tabulated data a graph was drawn indicating the difference in the drop-out rate between boys and girls. Chi-squared tests showed that these differences were very significant in each standard. ($p \leqslant 0{,}001$).

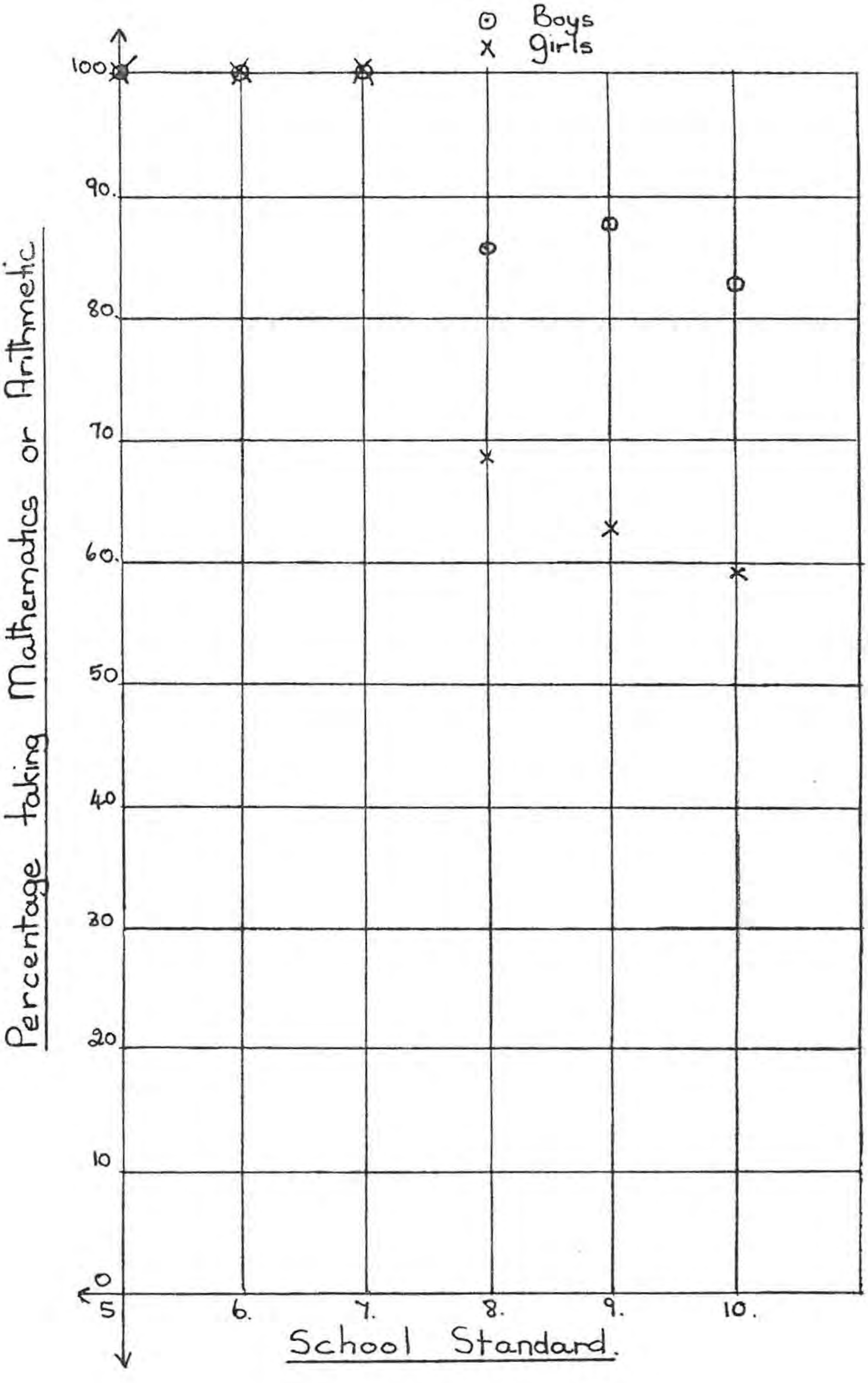
<u>Enrolment in Mathematics of White English-speaking Scholars in High Schools in East London in 1983.</u>

School Standard		Number taking mathematics	Number not taking mathematics	Percent. taking math.	Percent. difference
8	Boys	247	41	85,8	16,9
	Girls	230	104	68,9	
9	Boys	270	39	87,4	24,5
	Girls	188	111	62,9	
10	Boys	202	42	82,8	23,6
	Girls	154	106	59,2	

The study is cross-sectional and for this reason it is not possible to compare the drop-out rate of one group as it progresses through the different standards. A longitudinal study over a period of three years would have had the advantage of showing how the drop-out rate from Standard 7 to Standard 8 changed in Standard 9 and again in Standard 10. Although it would appear from the given table that the difference in the drop-out rate increases after Standard 8, one could not assume this from the data because of the cross-sectional nature of the study. Similarly, it cannot be assumed that the difference in the drop-out rate between boys and girls improves in Standard 10.

One of the disadvantages of cross-sectional studies is that they do not take cultural changes into account although these are only really important over a long period of time. Cul-

Percentages of Boys and Girls taking Mathematics in each Standard in Five East London High Schools.



tural changes affect values among other things. It is possible that with the increasing awareness of the importance of mathematics for girls for career purposes, fewer girls will drop mathematics and the difference in the drop-out rate between boys and girls will be less. Fortunately the pupils being considered followed a syllabus that has remained unchanged for at least three years. What is very evident however, is that the problem still exists. Far fewer girls are continuing their studies in mathematics than boys. By avoiding high school mathematics, women have limited their opportunities for further study as well as their career options and their quality of intellectual life. As society becomes more technological and computers play an ever-increasing role in almost every aspect of life, women who do not have sufficient Mathematics are barred from the more lucrative and challenging professions and lead restricted lives.

If a solution is to be found to the problem, an answer must first be given to the question "Why is it that so many girls choose to terminate their mathematics studies as early as possible?"

A review of the literature on sex-differences in Mathematics reveals that a number of possible reasons exist for the boy-girl differences in the drop-out rate, one of which is attitude toward Mathematics.

C H A P T E R 2

LITERATURE SURVEY

2.1 INTRODUCTION

In this chapter boy-girl differences in mathematical ability, achievement, socialization experiences and attitudes towards mathematics will be investigated as possible factors affecting the drop-out rate.

It is extremely difficult to isolate these factors as they present a very complex pattern of inter-relationships where each factor influences and is influenced by the others.

Test results indicating differences in performance in Mathematics between boys and girls are sometimes taken to be indicators of differences in ability between boys and girls. Both performance and ability are inter-related and affect each other but they are also affected by other factors such as socialization experiences and attitudes. All the factors mentioned not only interact with each other but each affects boys and girls differently. Conclusions therefore about cause and effect would be extremely difficult to make based on the available research findings.

It is possible, in some instances, that poor achievement in Mathematics is a result of a combination of adverse attitudes, poor ability and socialization factors. In another instance it may be contended that adverse attitudes are a result of poor performance and socialization influences.

2.2 MATHEMATICAL ABILITY

The question that is asked is the following:

"Are there sex differences in Mathematical ability and if so are these differences because of innate or because of socially induced factors?"

The pre-1975 studies indicate that sex-related differences in ability may be found only in pupils of above-average ability and in mathematical problems whose content is spatial or sex biased. When children are given intelligence tests with items balanced so that neither sex is favoured, there is no difference with respect to general intelligence.

There are, however, consistent differences on the sub-test scores with males excelling in certain mathematical areas (Maccoby and Jacklin, 1974), especially with respect to visual-spatial tasks. (Fennema and Sherman 1977)

Studies have claimed that the greatest differences in mathematical ability are those in spatial visualization (Fruchter, 1954., Maccoby and Jacklin, 1974., Werdelin 1961). Spatial visualization includes the ability to visualize three-dimensional objects and the ability to rotate objects in space. Spatial ability has been claimed to be an important predictor of Mathematical advancement in girls. Some of the reasons given for the differences between boys and girls in spatial visualization are: strength of cultural pressures, the process of sex-role identification and biological reasons (Burton, 1978).

2.2.1 Biological Reasons

Until the 20th Century male intellectual superiority was seldom questioned. Early research on the question was precluded by the lack of co-educational institutions as well as the lack of sophisticated testing techniques.

Although few believe today that mathematical ability in general pertains only to the male sex, there still appears to be a case for male superiority in spatial ability. Three biological reasons have been suggested to explain these spatial ability differences.

(i) Recessive Gene Theory

It has been suggested that the sex difference between males and females in spatial ability is caused by a recessive sex-linked gene located in the X-chromosome. Males having both an X and Y chromosome will manifest such a recessive trait more frequently than females who may carry an offsetting dominant gene which can overrule the recessive trait.

(ii) Hormonal Differences

Experiments have suggested that male superiority on spatial tasks has something to do with the fact that males have only a small amount of the hormone estrogen in their blood. Estrogen is an activating hormone and it was thought that the ability to inhibit incorrect responses provided evidence for male superiority in re-structuring tasks.

(iii) Brain Lateralization

The most recent explanation suggested to explain differences in spatial ability is that of brain lateralization. This is based on evidence that each hemisphere of the brain "specializes" in a particular function --- the right side dominantly for spatial tasks and the left for verbal and logical tasks. Sherman (1977) suggests that the early maturation of verbal ability in females hinders the development of their spatial skills.

Recent research studies have repeated the early electroencephalographic studies but with superior instrumentation and more rigid control over certain artifacts. They have concluded that, under the more controlled conditions, no evidence whatsoever can be found for the lateralization of different cognitive functions. Other studies which measure the blood flow patterns within the brain also show that the nature of mental activity does not alter the left-right symmetry, although blood-flow patterns do change (Siff, 1983).

Theories attributing differences in performance on spatial tasks to genetic, metabolic and hormonal differences have also been described and evaluated by Sherman (1978) and generally found lacking.

Although a number of studies claim that males excel in spatial tasks, Fennema (1977) concludes the following with regard to spatial visualization in her study of four schools

> "Given the numerous long-standing conclusions of sex-related differences in spatial visualization, findings of small differences in only two high schools are contrary to expectations and consistent with the growing scepticism about this and other sex-related differences."
> (Fennema & Sherman, 1977 p 66)

It was also found in the above study (Fennema and Sherman, 1977) that when the differences between sexes in the number of space-related courses taken in the two schools was co-varied out, the sex-related differences in spatial visualization were eliminated. This appears to indicate that practice and relevant experience are factors in the differences between the sexes in spatial visualization.

Another important issue which should be raised is whether or not superior spatial visualization implies improved mathematics learning. Spatial visualization and mathematics are inseparably intertwined and one would expect that the better spatial visualization a pupil has, the better he would be able to grasp certain sections of mathematics, especially geometry and trigonometry. Although this relationship between mathematics content and spatial visualization skills appears logical, the results from empirical studies which have explored this relationship are not consistent. In 1967, Very concluded

> "Research on spatial ability has failed to produce any significant correlator (of the spatial factor) with any facet of mathematical performance."
> (Very, 1967. p 39)

Even in geometry where one would expect to find the strongest relationship, empirical findings do not indicate clearly that the two are related. Lim concluded in 1963 after a thorough review of the available literature, that the evidence for a relationship between geometric ability and spatial visualization was inconsistent and unreliable.
(Jacobs, J., 1978. p 17)

Other authors, however, feel that data indicates a positive relationship between problem-solving and spatial ability. Aiken concluded that spatial-perceptual ability was one of the most salient mathematical factors extracted in various investigations. (Aiken, 1973). According to more recent studies conducted by Meyer (1976) and by Fennema and Sherman (1978) there appeared to be no sex-related differences in the relationship between spatial and mathematical skills, even in the few groups in which there were sex-related differences in performance in either spatial or mathematical skills (Jacobs, J., 1978. p 36). K. Schonberger (1979) and Sherman (1979) in later studies found that the relationship between spatial and mathematical variables appeared to be closer for females than for males.

The argument that biology determines spatial ability which in turn determines the ability to solve problems can be faulted on yet another account. If males were using their superior spatial ability in solving problems, the correlations between spatial ability and problem-solving ability would be expected to be greater for males than for females. This is in fact not so.

In conclusion, it would seem that there are no innate differences in general mathematical ability. The case for boy-girl differences in spatial ability is not really conclusive on the basis of the available information. If, however, such differences do exist, they appear to favour males and are probably due to cultural pressures, sex-role identification and sexism in the items of the tests on which conclusions were based, rather than to biological reasons. With regard to the relationship between the learning of mathematics and spatial ability, the nature of the relationship is not clear at all and there is an obvious need for more data before conclusions can be reached. Even less is known about the effect that differential spatial visualization has on the mathematics learning of males and females.

2.3 SEX-RELATED DIFFERENCES IN ACHIEVEMENT IN MATHEMATICS

Many studies have concerned themselves with the comparative learning of mathematics by females and males. Nearly all reviews of research published before 1974 concluded that

while there might not be sex-related differences in mathematics achievement in young children, by the time they reached upper elementary or junior high school level, male superiority was always evident. Males were definitely considered superior on higher level cognitive tasks.
Literature reviews published after 1974 do not show the same consensus about male superiority. In a 1974 review which synthesized information from 36 studies, it was concluded that there were no sex-related differences in mathematics achievement of elementary school children and little evidence that such differences existed in high school pupils. There was some evidence that boys excelled in higher level cognitive tasks and girls in lower level cognitive tasks but there is still no consensus on whether sex-related differences in mathematics achievement actually exist or not. (Jacobs, J., 1978. p 7)
Schonberger (1978) in her review of the research on problem-solving available in 1975, suggests that better male performance, if found at all, was usually limited to students of higher ability and to certain types of problems.
(Lindquist, M., 1980)

More recently completed research (Fennema and Sherman 1977, 1978) found few sex-related differences even in problem-solving.
In the Study of Mathematically Precocious Youth, many males out-performed any female. In the 1973 Talent search 7% of

the boys scored higher than any girl and the boys' mean score was significantly higher than the girls' mean score. (Jacobs, J., 1978. p 11)

It would appear therefore that there are differences in the results of the different studies.

The discrepancies between earlier and later studies could be attributed to various factors :-

(i) There is a possibility that pupils have changed in the twenty years covered by this research as they have been years of great change, especially for women.

(ii) The content of the tests could also be a factor contributing towards the disparity of findings between earlier and later studies. The National Longitudinal Study of Mathematical Abilities done in the mid-1960's in the U.S.A. with pupils in grades four through eleven, found a statistically significant difference in performance, favouring males on almost all of the number series scales at the highest cognitive level. On examination it was found that the scales contained problems about people and in almost all cases in which the sex of a person was specified, the person was male. More recent studies of mathematical problem-solving using tests in which sex-bias has been eliminated, have found few, if any, sex-related differences in grades four through eight (Lindquist, M., 1980. p 187).

A large-scale study by researchers at the Educational Testing Service in U.S.A. in 1979 evaluated items and performance data from grade 10 of the Sequential tests of Educational Progress and from grades 5 to 8 of the Iowa Tests of Basic Skills. On people-centred items of the mathematics tests, the only differences which were significant were in favour of males in grade 10 on items referring to males (STEP) and in favour of females in grade 5 on items with female or neutral references or roles (ITBS).

In recent years there has been an increased awareness of sex-bias in test items and attempts have been made to minimize or eliminate this bias. It is possible that these changes in test items could also have eliminated some of the sex-differences in achievement which were recorded in previous or earlier studies.

(iii) Probably the most important factor, however, contributing towards the discrepancies is the lack of control for participation in the number of mathematics courses. Many early studies in the U.S.A. did not control for the number of courses taken, which meant that conclusions about male superiority were based on studies where a better mathematically educated group of males was being compared with a group of females who had taken fewer mathematics courses. In fact what was happening was a comparison not between females and males but between pupils who had studied mathematics for two to four years and pupils who had studied mathematics for one to three years in high school.

The 1978 California Assessment of students in grade 12

found that girls in all participation groups did better on computation, whereas boys in all groups did better on all types of measurement items (except money items) and also on geometry problems, probability and statistics.
The difference in measurement items was also noted in the Second National Assessment of Educational Progress reports of 1979. Measurement skills, however, are taught in scientific and vocational courses as well as in mathematics. When the students were grouped according to how much mathematics <u>and physics</u> they had studied, no sex-related differences in quantitative performance were found.
(Lindquist, M., 1980. p 188)

The National Science Foundation in the U.S.A. sponsored a study conducted by Fennema and Sherman, data for which were collected in 1975 - 1976. This study investigated a variety of levels of mathematics in grades 6 to 12 as well as cognitive and affective variables hypothesized to be related to differential mathematics achievement by females and males. The results of the study can be generalized fairly widely because of the diverse, carefully selected sample. In grades 9 to 12 (n = 1233) with subjects whose mathematics backgrounds were very carefully controlled, significant differences in achievement in favour of males (approximately two items) were found in two of the four schools involved in the study. In grades 6 to 8 (n = 1330) sig-

nificant differences were found in favour of females in a low cognitive level mathematics task in one of the four tested school areas. In another of the four school areas, significant differences were found in favour of males in a high cognitive level mathematical task. (Jacobs, 1978) Keeves (1973) reports that male superiority over females in mathematics achievement was found in all 10 countries which participated in the First International Study of Educational Achievement.
In Australia, females are reported to be superior on problem-solving and computation tasks in grades 5 to 8, while males were found to have performed better in space tasks. (Jacobs, 1978). As it is not known whether or not these tests were controlled for participation in mathematics, or sex-bias, the validity of the results cannot be commented on.
In Britain where mathematics is generally not optional before school-leaving age and mathematics background is therefore more easily controlled than in the U.S.A., it has been found that boys are more successful than girls in public examinations in Mathematics (Cockcroft, 1982. p 276).
Girls under-achieve in public examinations in mathematics compared with boys, while in English the position is reversed.

The First Assessment of Performance Unit Secondary Survey 1979 found that by the age of 15/16 the composition of the top 10% of achievers was boys 61,5% and girls 38,5%. The difference between proportions of boys and girls in the middle 10% of achievers and the bottom 10% was small.

In 1973 and 1974, Wood analysed performance on the London Board O - level syllabus C papers. He found that none of the items on which girls out-performed boys required problem-solving behaviour, instead they call for recognition, classification, the supply of definitions, application of techniques, substitution in algebra and operations which lend themselves to drilling. (Sex Differences in Mathematics Achievement at G.C.E. Ordinary level, Education Studies 2.2 1976, p 141 - 160).

The testing done in 1964 as part of the International Study of Achievement in Mathematics (Husén, 1967) showed a similar pattern to that in the U.S.A. and Britain. In all twelve of the developed countries which formed part of the study, the performance of boys was higher than that of girls at the age of 13+ . The performance of boys was further ahead on problem-solving than on computational tasks. There was however, quite a difference between countries, the differences being greatest in Belgium and Japan and least in the U.S.A. and Sweden.

From the research on sex-related differences in school mathematics, the following conclusions are reached :-

(i) There are apparently no sex-related differences in the elementary school years. This applies to all cognitive levels from computation to problem-solving.

(ii) In high school, if differences appear, they tend to be in favour of males especially on tasks involving higher level cognitive skills.

(iii) There is some evidence to suggest that sex-related differences in achievement in high schools may not be as large at present as they were in previous years.

(iv) Conclusions reached about male superiority in the U.S.A. have often been based on studies which did not control for mathematics background and it is very likely that if the amount of time spent learning mathematics is equated for females and males, significant sex-related differences in mathematics achievement will be reduced, or even disappear.

2.4 SOCIALIZATION INFLUENCES

2.4.1 History

If one studies the history of mathematics it is evident that few women in the past have either entered or achieved recognition in the field of mathematics. Until the present century women were generally excluded from schools in which they could receive advanced training in mathematics.
Grace Burton in Perspectives on Women in Mathematics (Jacobs, Judith., 1978) examines the roots of our present

socialization patterns in the light of some of the past notions on the education of women. A selection of these quotations should give an idea of the position.

> "The education of women should always be relative to that of men. To please, to be useful to us, to make us love and esteem them, to educate us when young, to take care of us when grown up, to advise, to console us, to render our lives easy and agreeable ------
> Even if she possessed real abilities it would only debase her to display them."
>
> J. J. Rousseau, Emile, 1762

> When expressing your viewpoint use words that indicate insight such as "I feel". Avoid the words "I think", or "I know".
>
> Helen B. Andelin, Fascinating Womanhood 1965.

> Since women are deficient in reason but abundant in emotion, they ought no longer to be treated as rational, nor receive any mental education ------. Among women, we use language implying the utmost deference for their sex: and they fully believe that the Chief Circle Himself is not more devoutly adored by us than they are; but behind their backs they are both regarded and spoken of -------- by all except the very young ------ as being little better than "mindless organisms".
>
> Edwin A. Abbot, Flatland, 1884.

> When a woman inclines to learning there
> is usually something wrong with her sex
> apparatus.
>
> F.W. Nietzche, Beyond Good and Evil, 1886.

> A girl should not be too intelligent or
> too good or too highly differentiated
> in any direction. Like a ready-made
> garment she should be designed to fit
> the average man.
>
> Emily Jane Putnam, The Lady, 1910.

There are many even today who assert that men are superior to women in intellectual areas simply because they are men ------ the implication being that maleness itself ensures intellectual superiority.

Historically, biological reasons were often given to explain why women should not engage in intellectual activity. Until the turn of the century, it was believed by many, that women were innately incapable of rigorous study and that if such study were attempted, she could expect grave consequences to herself and her future offspring. It was believed that serious intellectual activity during adolescence caused harm to female reproductive organs and resulted in feeble, sickly children.

One gynaecologist in 1905 asserted that academic activity decreased the size of the pelvis and increased the size of the heads of future offspring ---- enough to put many women off in those pre-anaesthetic days (Bullough, 1973).

It is incredible to find that even in the present enlightened times the following statement is made in a book by Theo Lang published in 1971 :

> "Menstruation must have a retarding effect on a women's physical and mental development."
>
> (Jacobs, Judith., 1978, p 45)

Certainly much credit is due to those women in the previous centuries who successfully contributed to the field of mathematics in spite of difficult if not impossible handicaps. It would do well to look at the careers of just a few of these women.

2.4.1.1 Maria Agnesi (1718 - 1799)

Maria Agnesi was the daughter of a Mathematics professor at the University of Bologna. At the age of thirty she was given an honorary appointment at the University of Bologna. She did not, however, teach there. She wrote a two-volume analytic geometry text which was well accepted and widely used. It was also translated into English and French. She never pursued mathematics as a profession since it was probably not permitted for women at that time.

2.4.1.2 Sophie Germain (1776 - 1831)

Sophie Germain was born in Paris. During the violent

period accompanying the French Revolution she was confined to her house, where she spent many hours reading. Apparently the story of Archimedes' demise sparked her to explore Mathematics further.
Women were not allowed in the university, Ecole Polytechnique, but Sophie managed to procure notes of the lectures delivered by Lagrange. She wrote to Lagrange under the name M. le Blanc and was commended by him. This spurred her on to further studies. Germain then began correspondence with Gauss who was impressed with her ability, saying she had a "taste for the abstract sciences". He praised her too for overcoming the obvious prejudices of the day by studying mathematics. Sophie Germain published papers in Number Theory, Analysis and Elasticity.
Gauss proposed that she be given en honorary degree from the University of Göttingen for her achievement in the field of mathematics. She died before the degree could be awarded.

2.4.1.3 Sonya Kovalevsky (1850 - 1891)

Sonya was born in Moscow and her interest in mathematics was aroused and nurtured by her uncle Pyothr. When she was seventeen she went to St. Petersburg where she studied Calculus. Russian universities excluded women and Sonya decided to leave Russia. Since it was difficult at that time for single women to leave the country to travel abroad

she arranged a "marriage" with an understanding young man. She married at the age of eighteen and left Russia (without her husband) for Heidelberg where she studied mathematics until 1870. In 1870 she began private studies with Weierstrass and studied with him from 1870 to 1874, completing the university course in mathematics in three important papers. In 1874 she received a doctorate in Philosophy from the University of Göttingen.
She returned to Russia for four years, where she gave birth to a daughter in 1878. Her husband died in 1883 and Sonya returned to research. She became a professor at the University of Stockholm and was very well received.
Her greatest achievement was winning the Prix Bordin awarded by the Instut de France. Two years before her death the Russian Academy of Sciences elected her the first woman corresponding member.

2.4.1.4 Emmy Noether (1881 - 1935)

Emmy Noether was one of the great mathematicians of the 20th Century. Her father, Max Noether was a distinguished mathematician and a professor at the University of Erlanger.
She was tutored by her father and Paul Gordon and received her doctorate under Gordon in 1907. Emmy Noether's work at the University of Göttingen was halted during the uprising in Germany in 1933. She went to the United States where she lectured at Bryn Mawr College and Princeton's Institute for

Advanced Study. Albert Einstein wrote a tribute to Professor Noether, referring to her as a "creative mathematical genius".

To echo the words of Osen on the subject of women and mathematics

> "In almost any age, it has taken a passionate determination as well as a certain insouciance for a female to circumvent the crippling prohibitions against education for women, particularly in a field that is considered to be a male province. In mathematics the wonder is not that so few have attained proficiency in the field, but that so many have overcome the obstacles to doing so. We can only speculate about the multitude who were dissuaded from the attempt."
>
> (Osen, L. 1974. p 163)

2.4.2 Stereotyping of Mathematics as a Male Domain

Stereotypes embody the messages of the world in shorthand form. Appropriate behaviour for males and females is conveyed to children by parents, peers, teachers, advertising and the media.

Mathematics in our Western culture is considered incongruous to the female sex-role and this incongruity is transmitted to the children through the process of socialization.

Grace Burton in Perspectives on Women and Mathematics makes the following statement :-

> "In our culture, the stereotype that women aren't good at mathematics or that a woman who does not conform to this stereotype is somehow not really feminine, is well-entrenched. It will not be eradicated easily."
>
> (Jacobs, Juditn. 1978. p 53)

It is believed that sex-stereotyping of Mathematics as a male domain begins in the primary schools and becomes stronger during adolescence and is solidified as a male domain by adult years. Stein and Smithells (1969) and Stein (1971) provide evidence that mathematics is not considered a male domain until adolescent years and even then it is not ranked as highly masculine as are spatial, mechanical and athletic tasks. In the adult world the use and creation of mathematics is predominantly a male domain. Stein and Smithells (1969) maintain that by the twelfth grade, females realized this fact and were responding to reality.
The Fennema and Sherman study (in Arithmetic Teacher, 1977) showed that girls in grades six to twelve deny that mathematics is a male domain. The males in the study at each grade stereotyped mathematics as a male domain at significantly higher levels than did females. During adolescent years the cross-sex influence on all aspects of behaviour is strong and it would seem that since males stereotype mathe-

matics as a male domain, they communicate this belief to the females which influences their willingness to study mathematics. Lynn Osen says :

> "Many women in our present culture value mathematical ignorance as if it were a social grace."
>
> (Osen, L. 1974)

Newer studies show, however, that the sex-typing of mathematics is not as prevalent as it once was but there is evidence that male prejudice against girls' mathematical engagement still exists and that girls believe that it exists and in fact have accepted the stereotype that mathematics is a male pursuit (Fennema & Sherman, 1977; Tobias, 1978). According to Erika Schildkamp - Kundiger (Zweng, Green et al, 1983) there is empirical evidence to support the hypothesis that the sex-typing of mathematics is related to achievement differences in such a way that the linking of mathematics to the male domain is responsible for a great deal of any inferior achievements and participation of women in mathematics. Dwyer (1974) says that when a child perceives mathematics as appropriate for his or her sex, this influences the child's achievement in the subject ---- even more so than his or her liking for the subject.

2.4.3 Child-rearing Practices

A child's environment is furnished according to his or her sex. Boys are given significantly more spatial and scientific toys, rather than dolls which girls receive (Maccoby and Jacklin, 1975).

A survey of women mathematicians revealed that scientific toys were the most difficult toys to get from their parents, even when the girls asked directly for them. A recent British study found significant differences between the spontaneous play of boys and girls in nursery school. It was found that while girls engaged in creative spontaneous play, boys preferred more constructive play and play with sand and water (Eynard and Walkerdine, 1981).

Throughout childhood boys take part in more physical games and play more with construction toys. It is thought that this type of play promotes spatial awareness and problem-solving activity, while girls are expected to be relatively passive and conformist. Girls are encouraged to help mother around the house, cook, sew and wash-up rather than to help father with the car or "do-it-yourself" jobs which are more directly related to measurement, shape and calculation than are those assigned to the female role.

Boys apparently receive more attention, more praise and more punishment from adults who also imply by their response to boys that they find them more interesting and attention-provoking than girls (Deem, 1980).

The fact that their ideas appear to be more valued by adults encourages boys to put their ideas forward. This could be significant for later mathematics learning.
It seems therefore, that differences in child-rearing practices also play a part in the differences between boys and girls in mathematical ability, achievement in mathematics and attitudes toward mathematics.

2.4.4 Parental Expectations

Differential expectations according to sex and direct socialization by parents begin at birth (Rubin, Provenzo and Luria, 1976). Parents' expectations for their daughters and sons differ fairly widely ---- it seem that they generally expect a better performance in mathematics from their sons than their daughters. These expectations are communicated both directly and indirectly to the children by the parents. An observation concerning parental expectations with regard to mathematics was made by Emile Martin and appeared in the American Mathematical Monthly in 1917. To a certain extent this comment is still valid today.

> "Parents who would suffer keen mortification if the boy for whose education they are responsible were in danger of being rejected by his college because of his failure in required mathematics, will condone any shortcomings of the girls in that (area) with a deprecating

'You know that one does not think so much of a failure in mathematics for a girl'."

Emile Martin in American Mathematical Monthly, 1917 p 396.

Astin (1975) reported that in the "masculine" area of mathematics, their parents expected more from their sons than they did from their daughters. Parents can play an important role in developing the later mathematical progress of their daughters. Helson (1971) found that nearly all the women mathematicians she interviewed had grown up in homes where there had been a strong respect for learning and cultural values. Most of them had been rewarded for intellectual successes as little girls. Osen (1974) reports similar findings in her book Women in Mathematics.

One can but speculate on the probability that many girls underachieve in mathematics, or even drop out of mathematics at an early age simply because they are "living down" to their parents' expectations of them.

2.4.5 Peer Pressures

Peer pressures, especially for the adolescent girl, may be even more influential than that of parents (Lebold, 1976). Peer group pressures centre on the view of mathematics taken by children's contemporaries and on sex-stereotyping. According to Weiner (in Deem, 1980) peer group pressure increases in adolescence and is enhanced by the influence of pop-culture, the teenage magazines and the media. Stereotypes are still put forward which confirm the restricted image of the girl who is engaged in her mid-teens and married at twenty. The study of mathematics could appear to be pointless to girls who are influenced by these pressures. Luchins (1976) found that women who decide to continue studying mathematics receive less attention from their male peers. Mrs Helen Andelin, mother of eight children and author of Fascinating Womanhood and The Fascinating Girl, and conductor of Fascinating Womanhood courses in the U.S.A., warns young women who might be tempted to follow their own intellectual interests :-

> "Don't compete with (men) for scholastic honours in men's subjects. It may be all right for you to win over a man in English or Social Studies, but you are in trouble if you compete with him in math, chemistry, public speaking etc. Men may admire women who excel in them, but they are not apt to ask them for a date. Why? Because they have been defeated in their own field."
>
> (Andelin, 1970., p 164)

The tragedy of this is that it is very often the truth. Luchins (1976) in a study of 350 women mathematicians found that not only had almost half of them been discouraged by teachers and by peers on the grounds that "boy's would'nt like them" but that these women actually received less positive attention from men as they advanced to higher levels.

Peer pressure could certainly be taken to be one of the factors determining whether or not a girl chooses to continue her studies in mathematics, especially when one considers that the age at which she generally has to make the choice is the age at which peer pressure is most influential.

2.5 ATTITUDES

The generally low correlation between attitude and achievement is often cited as evidence that attitudes may not matter too much in explaining achievement. There are high achievers in mathematics who have low scores on mathematics attitude tests. Attitudes, however, are probably more closely related to factors such as staying in school, continuing with Mathematics throughout High School and selection of a career, than to achievement.
Fennema and Sherman (1977) suggest that positive attitudes may be an especially important selection factor for girls.

2.5.1 Sex Differences in Attitude towards Mathematics

Although some studies have failed to find significant sex differences (Merkel, 1974; Roberts, 1970), differences in both attitudes and achievement are often found to favour boys over girls at Junior-High School level and beyond

(Hilton & Berglund, 1974; Keeves, 1973; Nevin, 1973; Simpson, 1974). The correlation between attitude and achievement varies with the grade or standard as well as with the sex of the pupil and is generally somewhat higher for girls (Behr, 1973). This means that girls' mathematics marks would be more predictable from their attitudes than those of boys.

Greater mathematics test anxiety has been noted in girls than in boys and greater interest as well as more positive attitudes toward mathematics and science on the part of males has been found in the U.S.A. and other countries (Keeves, 1973; Nevin, 1973).

2.5.2 Relationships of Personality and Social Factors to Attitude toward Mathematics

In the primary as well as Junior-High School levels, attitude toward mathematics and achievement in mathematics are significantly related to a number of personality factors indicative of good adjustment. These include characteristics such as a greater sense of responsibility, a high sense of personal worth, high social standards, high academic achievement motivation and greater freedom from withdrawing tendencies (Naylor and Gaudry, 1973; Swafford, 1970).

In addition, children with positive attitudes towards mathematics tend to like detailed work, to see themselves as more persevering and self-confident (Aiken, 1972) and to be more

"intuitive" than "sensing" in their personality type.
Neale (1969) found that children who do well in mathematics are more conforming and obedient in school and according to Western (1969) their parents are more possessive. The influence of the parents is shown by the fact that the pupils' attitudes and achievement in mathematics are positively related to the attitudes of their parents (Aiken, 1972; Burbank, 1970; Levine, 1973). Present available research has failed to provide much enlightenment concerning the interactions of the attitudes of mothers and fathers with those of their daughters and sons.
Silverbank (1972) found that high school pupils talented in mathematics are less sociable than those talented in English. He also reports that mathematics majors tend toward extremes on the anxiety variable ---- they are either unusually secure or severely anxious. Level of anxiety interacts with introversion-extroversion in its effect on performance in mathematics. It has been found that on original learning retention and transfer of a mathematics lesson, introverts were superior if rules were presented before the examples. Extroverts, in contrast, were superior when rules were presented after the examples (Aiken, 1976). Extroverts were superior on retention tests when their anxiety level was high but superior on transfer tests when their anxiety level was low. The introversion-extroversion variable also interacts with sex in its effects on performance in mathe-

matics. Extroverted boys and introverted girls perform better within their own sex-group (Aiken, 1976).

2.5.3 Confidence in Learning Mathematics

Confidence in learning mathematics is a crucial factor in determining whether or not a pupil continues with his or her studies in mathematics (Fennema and Sherman, 1977).
Students with higher levels of confidence planned to take more mathematics than those with lower confidence levels.
Among the affective variables used in the Fennema and Sherman studies, confidence appears to be one of the more important in its relationships to female students and selection of higher-level mathematics courses. It was found that confidence was significantly higher in males than females in three of the four schools involved in the studies.
Other studies have also focused on confidence and found an even stronger relationship between confidence in mathematics and mathematics achievement than Fennema and Sherman did.
In recent studies conducted by Fennema and Reyes in 1980 (in Lindquist, 1980) it was found that teachers initiated more interactions with high-confidence students than with low-confidence students and high-confidence students, in turn, approached the teacher to talk about their work more often than low-confidence students. In addition high-confidence students tended to have more of the higher cognitive level interactions with teachers than low-confidence students.

Three studies also found that sex-related differences in confidence were more frequent than sex-related differences in mathematical achievement. In each case where boys and girls differed significantly in mathematics achievement, they also differed significantly in their confidence in mathematics. It could be argued that girls are less confident in mathematics because they achieve more poorly than boys. This, according to Fennema and Sherman seems unlikely since

(i) the sex-related differences in confidence occur before sex-related differences in mathematics performance are observed and

(ii) there are more instances of sex-related differences in confidence than in mathematics achievement and where there is a sex-related difference in achievement, there is also a sex-related difference in confidence but not always vice versa.

(iii) the lesser confidence of girls in their ability to perform in mathematics is consistent with their lesser confidence generally, an attitude not necessarily changed when performing at equal or superior levels to males.

2.5.4 Mathematics Anxiety

Mathematics anxiety is very similar to lack of confidence in mathematics. It is related to both mathematics achievement and the election of mathematics courses.

Anxiety should not be viewed as a pathological state that needs to be cured. It is an essential and complex feeling that does not always function in a facilitative way (Sieber, O'Neil and Tobias, 1977). Anxiety may be facilitative if the task on hand or the material to be learned is simple but anxiety can be detrimental and debilitating to performance when tasks are complex. Anxiety takes the learner's attention away from the task and focuses that attention internally (Sarason, 1975). Instead of concentrating on the learning or evaluative situation, the anxious student engages in negative thoughts, such as "I am stupid" or "I'll never understand this" thus reducing the level of performance. Much work has been done on general anxiety but comparatively little on mathematics anxiety. There does seem to be some relationship, however, between mathematics anxiety and general anxiety but it has not been studied in depth (Lindquist, 1980). It would seem that many people who are not generally anxious are anxious about mathematics. Laurie Hart Reyes says

> "Mathematics Anxiety can be described as involving feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and/or learning situations. Mathematics Anxiety can prevent students from doing their best, from passing

> fundamental mathematics courses,
> or from pursuing advanced courses in
> mathematics or the sciences."
>
> (in Lindquist, 1980; p 169)

Females tend to report higher levels of mathematics anxiety than males (Perl, 1979) but females also report higher levels of other types of anxiety than males. Because females are more willing to report their feelings than males and are also more open about emotions than males, some researchers believe that the higher anxiety reported by females is in fact not necessarily so (Maccoby and Jacklin, 1974). A consistent negative relationship has been found between anxiety and mathematics achievement; high achievement being related to low anxiety (Lindquist, 1980; p 170).
None of the studies investigating the relationship found a clear cause-effect relationship between mathematics anxiety and achievement in mathematics. A number of intervention programmes have been designed especially in the U.S.A. to reduce mathematics anxiety. These have been implemented and some programmes have been effective in reducing mathematics anxiety but few have been effective in improving achievement scores or increased mathematics course election.
There are different types of mathematics anxiety intervention programmes:
One type focusses on the content of mathematics, basing their programmes on the assumption that anxiety is caused by lack

of understanding, they attempt to improve knowledge of mathematical concepts and so reduce anxiety.

Another type that has been effective in reducing mathematics anxiety is desensitisation behaviour therapy. Desensitisation has also been used successfully to reduce test anxiety (Sieber, O'Neil, Tobias, 1977; Wine, 1971). The mathematics-anxious person is relaxed through a procedure of deep muscle relaxation. When in a relaxed state, the person is directed to picture a sequence of scenes. The early scenes are very slightly anxiety-arousing. After each of the scenes, the individual is brought back to the original relaxed state. The scenes then become more and more anxiety-arousing but the person is kept in a relaxed state. Thus the person tends to associate mathematics with a pleasant, relaxed sensation. This desensitisation is best administered by a trained counsellor or teacher and treatment varies from single one- to two-hourly sessions to several sessions.

Yet another approach uses a combination of the first two. The mathematics-anxious person is given instruction in mathematics and also counseled in reducing mathematics anxiety. Fennema and Sherman found mathematics anxiety to be strongly related to confidence in mathematics. Students high in mathematics confidence are inclined to be low in mathematics anxiety and vice versa.

Because these two attitudes are so closely linked it is sensible to think of them as one attitude with two dimensions -- -- confidence being the positive dimension and anxiety the negative.

Teachers need to be aware of pupils whose performance in mathematics may be reduced by debilitating mathematics anxiety. They should ask themselves if certain approaches to teaching mathematics are more anxiety-provoking than others.

2.5.5 Attribution Theory

Attribution theory deals with an individual's beliefs about the causes of behaviour, in particular the reasons one gives for succeeding or failing in a variety of experiences. It has recently gained attention from educators and does appear to have logical relevance to mathematics.
A person can attribute his success or failure to many different causes. A pupil getting an A in a mathematics examination may attribute success to his or her good luck, to help received from a teacher or friend, to having worked hard, to ability, to a good text-book etc. These perceived causes of success/failure or attributions fall into four major categories:
ability, effort, task difficulty and luck. These four categories have been organized along two dimensions, locus of causality and stability (Reyes in Lindquist, 1980; p 173).

The internal/external dimension indicates whether the cause is controlled within the person or outside the person. Internal causes of success or failure include ability or the student's decision to pay attention and work. External causes include such factors as the quality of the teacher's explanations or the difficulty of the problems. The stable/unstable dimension has to do with whether the factor may vary from time to time or not. Effort or luck as a cause of success/failure could vary from one situation to the next, while ability could remain constant.
From the table given below (Lindquist, 1980; p 173) we see that ability is stable and internal, effort is unstable and internal, task difficulty is stable and external and luck is unstable and external.

From previous research it appears that there are patterns of attribution that are related to characteristics of people

Category Scheme for Perceived causes of Success / Failure		
Stability	Locus of Causality	
	Internal	External
Stable	Ability	Task Difficulty
Unstable	Effort	Luck

and are relatively consistent within individuals. People who are high in self-concept are inclined to attribute positive outcomes internally and negative outcomes externally. People with low self-concepts, on the contrary, more often ascribe positive outcomes to external causes while they tend to attribute negative outcomes internally (Lindquist, 1980). Generally males and females differ in their attribution patterns. A very consistent finding is that females hold lower expectations of their own performance than males do of theirs. Females are more likely to attribute their own successes to unstable external causes and their failures to internal stable causes. Males, on the other hand, are inclined to attribute their own successes to ability and to search for unstable, external causes to explain failure. The idea of expectancies appears to be the critical issue in determining attributions.

> "Subjects who approached a task with a high degree of confidence attributed failure externally and success internally, while these trends were reversed for subjects initially low in confidence."
>
> (Deaux, 1976; p 346)

Sex differences in attribution seem only to appear when expectations by females and males differ (McMahan , 1973). If these patterns generalise to the learning of mathematics, one could hypothesize the existence of a cycle. Female pupils in high school tend to be less confident than their male counterparts. This lower confidence leads to more internal attribution of failure and external attribution of success. The attribution of success to luck or an easy assignment provides no foundation for increasing confidence or expectancies in the future.

It has been mentioned that confidence is more strongly related to mathematics achievement than some of the other affective variables (Fennema and Sherman, 1977). It is thus possible that there exists a self-perpetuating cycle of lower confidence, internal attribution of failure and external attribution of success which in turn could affect achievement or decisions to continue with mathematics. Further research is necessary to determine whether, in fact, such a cycle exists.

Attribution patterns would appear to be important in determining the amount of persistence and confidence with which students approach mathematics. People should feel that they have a certain amount of control over their lives and their learning of mathematics. If the pupils believe that effort is a cause of success or failure, they may also see that they can have some control over the mathematics they learn by controlling the amount of effort they put into it.

2.5.6 Perceived Usefulness of Mathematics

Perceived usefulness of mathematics is another important factor in determining whether students will choose to continue their mathematics studies. It probably also affects the amount of effort which they are prepared to expend in mathematics classes. Students who do not actually enjoy mathematics, elect to continue with it if they know that mathematics is necessary for their career goals. It would seem that many female pupils could be dropping out of mathematics because they do not have specific career goals or the information about the level of mathematics necessary for reaching these goals.

Fennema and Sherman (1978) found that among middle school and high school students, those who receive higher scores in mathematics achievement, see mathematics as more useful than the lower achievers do. They also showed that high school students' ideas about the usefulness of mathematics affect their decisions about how much mathematics to take. Those who perceive mathematics as useful to them tend to take more mathematics.

Perl (1979) found that views on the usefulness of mathematics discriminated between those who wish to continue with mathematics and those who do not. She also identified perceived usefulness as the most important attitudinal factor in explaining differences in mathematics course election between boys and girls. Hilton and Berglund (1974) in their studies of high school students came to similar conclusions. Fennema and Sherman (1977, 1978) found sex-related differences in students' views of the

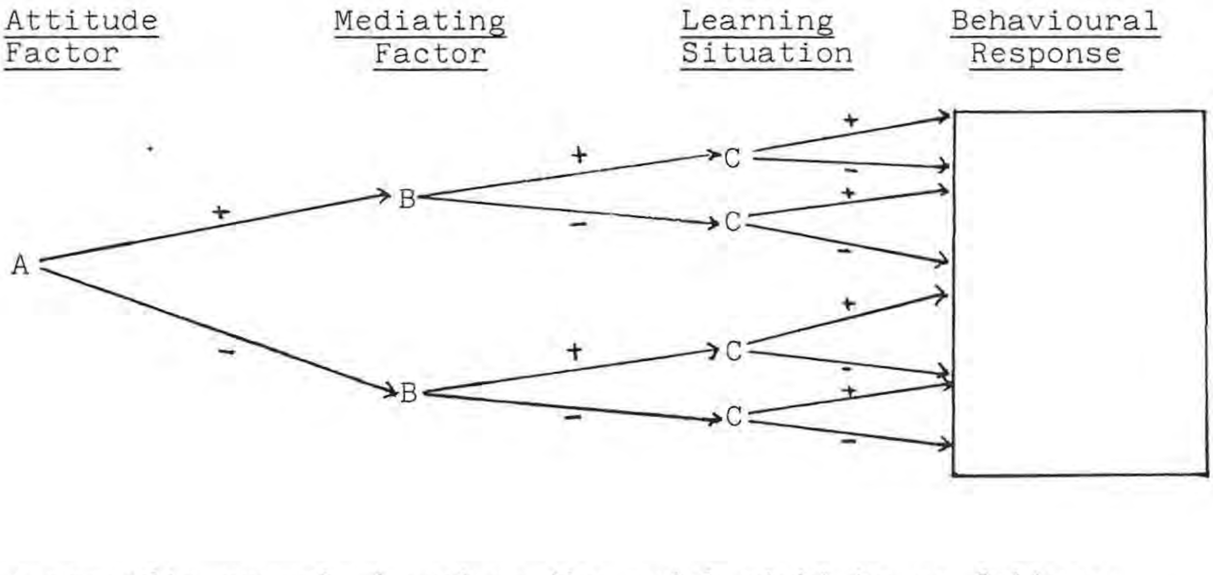
usefulness of mathematics only in those schools where they also found differences in mathematics achievement between boys and girls.
The implications of this truth should not be overlooked by teachers, parents and counsellors who prepare students for their future careers. Perceived usefulness of mathematics is probable the easiest of all attitudes to change.

2.5.7 A Model for the Relationship between Attitudes and Behaviour

Gerald Kulm in an article on Mathematics Attitude (in Shumway, 1980) proposed a model that illustrates the relationship between attitudes and behaviour. The theoretical bases for predicting behaviour from attitude include the idea that attitude produces a variety of responses, rather than a single response to a stimulus (Doob, 1947). Consider the example of a teacher giving a mathematics homework assignment to a pupil who has the attitude of "disliking mathematics". In the absence of this attitude, he or she would probably complete the task in the required time with the degree of success determined by ability and the instructional variables. Different students having the same attitude, that of "disliking maths", may react with careless work, late assignments or even playing truant from classes. The variety of responses possibly comes from the variety of reasons for disliking mathematics, together with opposing mediating variables such as the importance of the assignment, attitude toward the teacher, parental influence, difficulty of the assignment etc. The combination of these opposing variables that produces the final response may explain the weak relationship between mathematics attitude and achievement. The model presented is one representing the possible relationships among attitude-related factors and their implications for behaviour.

Model for Attitude-Behaviour Relationships

(Shumway, 1980; p 379)



A specific example based on the model might be as follows: A pupil feels that mathematics is useless (-A) but likes the mathematics teacher (+B). When given an easy homework assignment (+C) the pupil completes the work on time at the expected level of mastery(+Behavioural Response).

It can be inferred in this example that attitude toward the teacher is the stronger factor if the learning situation is not very demanding.

Some interesting questions arising from the model include the following:-

Are some attitude factors strong enough (positively or negatively) to overcome all mediating factors and learning situations? Are mediating factors or learning situations more important for negative attitude factors than for positive ones? What kinds of mediating factors overcome what kinds of attitude factors? The questions suggested by the model give rise to some specific hypotheses, all of the same general form:

Hypothesis: Given the attitude "enjoys mathematics", the subject will complete difficult homework assignments in the presence of a negative attitude toward teacher and insufficient instructional time.

Hypothesis: Given attitude factor A (+ or -), mediating factor B (+ or -) and learning situation C (+ or -), the subject's response will be (positive or negative).

Hypothesis: Given attitude factor A (+), the subject's response will be positive for any B and any C.

To make sure that these hypotheses are important and testable it would first be necessary to identify the domains for A, B, and C. That is, what are the attitudes (A), mediating factors (B) and learning situations (C) that are most relevant to mathematics learning.

2.5.8 Parents, Teachers and Mathematics Attitudes

A child's first experiences with arithmetic are usually in connection with his parents. One would expect, therefore, that the parents' attitudes and abilities in mathematics would affect their children's attitudes.

Studies have shown that at Junior-High School level pupil perceptions of parental attitudes are influential on both intended election of mathematics courses in the future and on their current performance (Lindquist, 1980; p 191). The correlation coefficients for high school studies have not shown, however, that students perceived their fathers' attitudes as more influential than their mothers', as several earlier studies seemed to indicate.

Peers, particularly in the case of girls and particularly where negative attitudes are involved, also influence attitude toward mathematics. Of greater importance, however, is the teacher's attitude and effectiveness in mathematics ---- this being viewed as a very important determinant of students' attitudes and performance in the subject.

Banks (1964, p 16 - 17) comments as follows:

> "An unhealthy attitude toward arithmetic may result from a number of causes. Parental attitude may be responsible -- -- repeated failure is almost certain to produce a bad emotional reaction to the

> study of arithmetic. Attitudes of his peers will have an effect upon the child's attitude. But by far the most significant contributing factor is the attitude of the teacher."

Numerous studies support this assertion. Phillips (1970) found that the degree of teacher understanding, effectiveness, and appreciation of mathematics, especially those of the most recent teacher, are significantly related to attitudes of the pupils. In addition improving teacher attitudes can result in more positive attitudes on the part of the pupils (Aiken, 1972).

2.5.9 Attitude Development and Stability of Attitudes

Most experimental treatments have been ineffective in producing significant improvement in mathematics attitudes according to Geral Kulm (in Shumway, 1980). This raises questions concerning the direction and magnitude of change or the permanence of change. The concept of changing attitudes implies also, that attitudes have been formed and are, to some extent, stable. It can however, be argued that attitudes are in a continuous state of formation and change, thus making meaningless the question of how to change attitudes. It is generally recognized that attitude toward mathematics in adults can be traced to childhood (Morrisett and Vinsonhaler, 1965; p 132). There is evidence that very definite attitudes toward arithmetic are formed in the early

grades and that these attitudes tend to be more positive than negative in the elementary school (Stright. 1960). Since attitudes are affected by development, they are probably not very stable in the early grades. The preciseness with which pupils can express their attitudes also varies with their level of maturity.
It would appear that the negative attitudes are formed largely in the first few years of high school. The results of a number of studies point to the persistence of negative attitudes toward mathematics as students ascend the academic ladder. In the early high school years, algebra and other abstract mathematics is usually introduced. It is note-worthy, therefore, that 40% of the prospective teachers surveyed in a study by Reys and Delon (1968) reported the Junior-High School years as the period when their attitudes toward arithmetic reached a peak of development. According to Dutton (1968) Junior High School seems to be a critical point in the determination of attitudes towards mathematics. The experimental evidence in the present research project also points to this.

Whether the issue involves the change or the foundation of attitudes, it is very important to remember that these attitudes exist in individuals rather than groups. Researchers who report no improvement in attitudes after a given treatment, sometimes overlook the fact that for some individuals significant changes, both positive and negative, actually did take place.

In the assessment of any long-term process, like the formation or change of attitude, it is essential that longitudinal or developmental research designs are used in addition to the more usual cross-sectional surveys. There have been very few longitudinal studies of attitudes to date.

Since school-related attitudes appear to be among those that form gradually, it would be valuable to obtain an answer to the question ---- Are attitudes that are formed gradually more resistant to change than those that are formed quickly?

It would appear that before any definite conclusions can be made about attitude stability or change, more research is necessary in this field especially longitudinal studies of attitude.

2.6 THE IMPACT OF SCHOOLING

2.6.1 Sexism in Mathematics Textbooks

Textbooks and teaching materials are very often sex-biased. The implicit and explicit message permeating mathematics education ---- from textbooks and tests to the teachers themselves ---- is that mathematics is a male subject. Textbook examples and problems tend to cast males and females in their traditional roles. The answer, according to Nibbelink (in Jacobs, 1978; p 76) is not to use gender-free labels, since this merely preserves the status quo --- the child assigns genders to the roles in a way consistent with what the community exhibits. He suggests that the way to deal with the problem is to use half males and half females randomly assigned to roles.

There has been, in recent years, a growing awareness of the problem of sexism in textbooks. It still prevails however, mainly in the form of a reluctance to place males in "female roles" and females in "male roles".

It seems reasonable to assume that sexism in mathematics textbooks, since they are used throughout the child's school career, could affect the child's attitude toward the subject.

The Minneapolis Public Schools have made a major commitment to eliminating sexist learning materials from the schools. The Women's Studies and Equal Education departments have provided staff for the selection committees that choose mathematics learning materials. The sex equity guidelines that were developed for selecting mathematics materials are given below.

<u>Guidelines for Selecting Materials on the Basis of Sex Equity.</u>
(Ross-Taylor, 1983; p 15)

<u>Guidelines used by Minneapolis Public Schools</u>

Step 1: Compare the number of word problems by sex.
*Is there an equal number of females and males in word problems?

Step 2: Compare the activities of boys and girls in word problems.
*Are boys more active than girls?
*Are both boys and girls shown in a wide range of activities?

Step 3: Compare the activities of adults in word problems.
*Are both men and women involved in a wide range of activities?

Step 4: Compare the occupation of adults.
*Are women shown in only a limited number of occupations?
*Is there an equal number of men and women shown in occupations?

Step 5: Compare the activities of boys and girls in illustrations.
*Are boys shown as active and girls shown in passive activities?
*Is there an equal number of illustrations showing boys and girls?

Step 6: Compare the activities of adults in the illustrations.
*Are men shown as active and women as passive?

2.6.2 Differential Treatment of Pupils by Teachers

Differences between the treatment of boys and girls by teachers occurs even in Primary School. A survey done in Britain in 1973 found that boys engage in more of the type of activity that helps to familiarise them with geometrical ideas than do girls (Cockcroft, 1982; p 281).

Children in Primary Schools are often assigned tasks appropriate for their sex ---- boys are asked to move physical education apparatus while girls tidy up the classroom. Primary School teachers apparently see girls as sensible, obedient, hard-working and co-operative while boys on the other hand are excitable and talkative, needing more supervision and attention (Cockroft, 1982; p 282). It has already been mentioned that Secondary School teachers appear to interact more with boys than they do with girls and they also give more serious consideration to boys' ideas. Boys are also given more opportunity to respond to higher cognitive level questions than girls and high-achieving girls receive significantly less attention in mathematics classes than do high-achieving boys.

Rowe (1974) found that teacher expectations for high-achieving students versus low-achieving students resulted in different wait-times for each group. Tobin (1979) found that increased wait-time produced an increased level of achievement. Gore and Roumagoux (1983) conducted a study in the U.S.A. in order to assess differences in teacher wait-time for boys and girls during mathematics instruction. The results were consistent with literature: teachers gave significantly more wait-time to boys than girls. Research suggests that wait-time is a factor that could possibly account for some or part of the differences in mathematics performance and/or attitude between the sexes.

Teachers need to give to <u>all</u> pupils adequate time to answer questions. By systematically giving boys more time and girls less time, a cumulative effect could be built up in co-educational schools, causing girls to become discouraged and possibly even causing them to achieve less relative to boys.

2.6.3 Boys take subjects which complement and assist in the Learning of Mathematics

Mathematics is not only learned in mathematics classes. A good deal of mathematics is learned in science as well as subjects like technical drawing. Not only is mathematics learned and practised in a practical context in these subjects but pupils become aware of how useful mathematics is in the technical and scientific employment worlds, especially in the traditional worlds of men's employment. Since more boys than girls take these subjects they are afforded more opportunities of practising mathematics and perceiving the usefulness thereof.

2.6.4 School Organization

There is evidence that schools influence sexual stereotypes. Minuchin (1971) concluded that pupils who attended schools categorized as traditional or modern, differed in their sex-typed reactions. The interaction of the sexes also differed in the different schools. In the most traditional school boys become leaders in problem solving and girls become followers. This was not the case in the less traditional schools. The sex-role behaviour of children attending traditional schools, tended to be more rigid than that of children attending liberal schools.

Casserly (1975) found that certain schools in the U.S.A. were more effective in persuading females to attempt high achievement in mathematics. She identified thirteen high schools with unusually high percentages of females in advanced placement mathematics and science classes. She concluded that these girls had been identified by the schools as early as the fourth grade and the teachers and peers were supportive of high achievement by females.

It has been advocated that single-sex schools or single-sex classrooms could be the answer to equity in mathematical education. Since peer pressure against female competitiveness is too strong a force, it is argued, females will not compete against males in mixed sex classrooms. Female leadership would be able to emerge unhindered and teachers would not have different sex-related expectations and behaviour if only one sex were present. Single-sex classrooms appear to provide a simple solution to a complex problem.

Fennema and Meyer (1976) in an unreported study comparing attitudes of tenth-grade females who had spent most of their educational lives in single- or mixed-sex classrooms, found that females from the mixed-sex classrooms exhibited significantly more positive attitudes toward mathematics than those from single-sex classrooms.

It would be necessary to examine, carefully, the long-term effectiveness of single-sex classrooms before deciding that they provide the answer to females' educational equity.

There seems to be some evidence that girls in single-sex schools achieve more in mathematics than do those in co-educational schools.

CHAPTER 3

ATTITUDES ---- DEFINITION, CHARACTERISTICS AND MEASUREMENT.

3.1 WHY ATTITUDES?

The existence of a major area of research on attitudes toward Mathematics is strong proof that it is of great concern to many educators.

Beliefs about an object or situation, for example, studying or teaching mathematics, determine one's attitudes towards it. These attitudes, in turn, influence a person's intentions with respect to the object and these intentions then predict a person's behaviour toward the object.

Aiken who has done a considerable amount of research in the U.S.A. on attitudes toward Mathematics has the following to say:

> "Scores on attitude scales may be better predictors of choice behaviour, satisfaction and perserverance than of achievement. Thus one would expect that a student's attitude toward mathematics would be important in determining whether he elects to take courses in mathematics, engage in mathematical activities, and to persevere in these efforts once he has begun."
>
> (in Riedesel, 1972; p 231)

It is generally felt that pupils who like mathematics and are interested in the subject will put greater effort into their studies and this will lead to higher achievement and to willingness to continue their studies in Mathematics. Many factors influence pupils as they make decisions about how much mathematics to take at high school and university. Research has shown that attitudes or feelings about mathematics are important factors in the pupils' decisions. In an article on Attitudes and Mathematics, Laurie Hart Reyes says:

> "Attitudes influence a student's willingness to enrol in more mathematics courses" and "how much effort a student will put into learning mathematics."
>
> (Lindquist, 1980; p 163)

If attitudes have an influence on the pupils' willingness to take more mathematics, it would seem reasonable to examine differences in attitudes toward mathematics between boys and girls as a possible or partial explanation for the differences in the drop-out rate between boys and girls.

3.2 DEFINITIONS

There is probably no definition of attitudes toward mathematics which would be suitable to all situations. Rokeach (1972) defines attitude as

> "an organisation of several beliefs focused on a specific object or situation predisposing one to respond in some preferential manner."
> (Rokeach, 1972; p 159)

Two definitions of attitude in general have been used by mathematics educators who have done extensive research in the field of attitudes toward Mathematics.
Romberg and Wilson (1969) described attitudes as follows:

> "If an individual has a set of predispositions toward an object in the environment (e.g. Mathematics, self, school, teachers etc.), it is reasonable to expect that such predispositions would interact with the perception of the object in such a way as to affect the individual's response to that object."
> (Romberg and Wilson, 1969; p 151)

Aiken in one of his reviews (Aiken, 1972) says that attitude toward Mathematics, as it is used in most situations or studies, means much the same thing as enjoyment, interest and to a certain extent, level of anxiety.
The causal relationship between attitudes and behaviour is not clear at all. This difficulty of determining the direction of causality is present in all ex post facto research. Although there is evidence to suggest that attitudes influence behaviour, there is also evidence that behaviour influences attitudes. With attitudes towards

school subjects the controversy becomes even more complex because behaviour is also related to academic achievement. There is evidence to support the case of achievement influencing behaviour and also of behaviour influencing achievement. A dislike for Mathematics (attitude) could cause inattentiveness in class (behaviour) whereas obtaining an A for a Mathematics test (behaviour) might influence how one feels about mathematics (attitude). When one considers that attitudes and behaviour are affected by social pressures, parents' and teachers' attitudes as well as mathematical ability, the whole situation becomes even more complex.

3.3 THE NATURE OF ATTITUDES

Attitudes can be said to have three components

(i) a belief component

(ii) an emotional component and

(iii) an action-tendency component.

3.3.1 The Belief Component

The belief component may be made up of any of the following: sound factual arguments, stereotypes, generalizations, rationalizations of the person's previous actions, completely unfounded ideas that were suggested by someone else or assumptions of which the person is unaware. The belief for instance, that mathematics is not for girls, could exist because of the stereotyping of males in mathematics-related roles and females in purely domestic roles. Belief structures have been described in terms of their vertical and horizontal structures.

Vertical Structure refers to the presence or absence of premises supporting the belief. A belief which is not based on other more explicit beliefs and which is accepted by the believer as true and important simply because it was given to the believer by an authority he or she accepted, is known as a primitive belief. Primitive beliefs have no supporting premise, that is, no vertical structure. A father who tells his daughter that mathematics is too difficult for girls could evoke in her a primitive belief if she accepts the statement unquestioningly. Many of the beliefs held by young children are primitive and since these beliefs are not based on factual arguments or reasoning, rational attempts to dissuade children from their primitive beliefs cannot be effective.

A Higher-order belief is based on a vertical structure of supporting premises.

Horizontal Structure refers to the presence or absence of independent and parallel premises supporting the same belief. The same surface belief may have many different sets of vertical arguments supporting it.

It is possible for higher-order beliefs to revert to primitive beliefs if, with the passing of time, the wellreasoned premises on which they were originally based, fade from memory. The belief remains but support has disappeared and the belief is therefore primitive.

3.3.2 The Emotional Component

The emotional components of attitudes may be learned through first- or second-hand experience with the objects of those attitudes or even through chance associations between the objects and other completely irrelevant events. Both positive and negative attitudes involve our feelings and emotions. A child whose first experience with mathematics was associated with fear or embarrassment could find that he dreads mathematics and mathematical activities throughout his school life and even after. The emotional component can sometimes be the major determinant of the attitude, overriding all else.

3.3.3 The Action-tendency Component

A change in beliefs and feelings about something or someone usually goes hand-in-hand with a change in behaviour toward the person or object. In the same way that a person may have a number of incompatible beliefs and hold irrational feelings about objects, so he can behave in a way that is inconsistent with his other behaviour tendencies or with his beliefs, feelings and emotions, that is, with his attitudes.

The actual concrete behaviour with respect to an object is a result of the convergence of all the different and incompatible beliefs associated with the object, the many different and often contradictory feelings about the object and the specific momentary situation in which the behaviour occurs.

3.4 CATEGORIES OF MATHEMATICS WHICH ARE MEASURED

The following table given by Gerald Kulm shows some of the aspects of mathematics teaching and learning which can be included in attitude tests (Shumway, 1980; p 359).

ATTITUDES	POPULATIONS		
Objects and Situations	Students	Teachers	Others
Mathematics Content			
Mathematics Characteristics			
Teaching Practices			
Mathematics Classroom Activities			
Mathematics Teaching			

3.4.1 Mathematics Content

Few attitude scales or items focus on mathematics content, that is, on specific sections of mathematics such as fractions, word-problems, geometry, factorising etc. Very often the questions take a general form such as "I like Mathematics" rather than "I like fractions" or "I like geometry riders". It is possible that a somewhat different picture would be presented by asking questions on specific sections of mathematics. In the present study Section C of the questionnaire consists of items involving algebra and geometry rather than mathematics in general. Section A of the questionnaire has an item which specifies "word problems".

3.4.2 Mathematics Characteristics

The majority of measuring instruments and items measure attitudes towards characteristics of mathematics --- such as its usefulness, importance, relevance, difficulty and interest.

3.4.3 Teaching Practices

Attitudes in this category are usually used to assess effects of teacher training and the questionnaires are completed by teachers rather than pupils. Very few studies using innovative teaching strategies have used items that require pupils to respond to teaching practices. Items of this type could reveal valuable information about the impact on pupils, more so than items concerning a general enjoyment of mathematics. Items relating to teaching practice could also give an indication of why pupil attitudes toward mathematics were, or were not, changed by the experimental treatment.

3.4.4 Classroom Activities

This category includes items about homework, the writing of tests and answering the teachers' questions. These items actually measure attitudes toward these various activities and not necessarily toward mathematics itself.

3.4.5 Mathematics teachers

Where teachers are included in the categories, as in the table given previously, it is not always clear whether the attitudes measured are towards teachers in general or specifically towards mathematics teachers. The present study does not include any items dealing specifically with pupils' attitudes toward teachers.

3.5 THE MEASUREMENT OF ATTITUDES

Five categories for attitude assessment are given by Kiesler, Collins and Miller (1969)

1. Self Reports.
2. Observation of behaviour in a natural setting.
3. Reaction to partially structured stimuli.
4. Performance on "objective" tasks.
5. Physiological reactions.

3.5.1 Self-report Scales

There are too many attitude scales to attempt a list of them all but the Thurstone and Likert attitude scaling techniques are among the most popular for measuring attitudes toward mathematics.

In Thurstone's method of equal-appearing intervals, each of a series of statements which reflect different degrees of negative and positive attitudes towards something is given scale value ---- the median of the scale values given to it by a group of judges. The final score is obtained by taking the sum or mean of the scale values of the statements which have been endorsed.

The most widely used self-report procedure has been Likert's summed-rating approach. The subject indicates whether he strongly agrees, agrees, is undecided, disagrees, or strongly disagrees with each of twenty or so statements which express positive or negative attitudes toward something.

The final score is the sum of the weights (numerical values) which have been assigned to the particular responses made.

On both the Thurstone and Likert scales, high scores indicate a more favourable attitude toward the particular topic of the scale e.g. mathematics.

One of the most recently developed self-report scales is the Semantic-differential. A list of bi-polar adjectives at opposite ends of a continuum separated by a fixed number of points is used to represent a concept. The subject then responds to the concept and the mean score along the continuum for each adjective is used as a measure of that attitude component. The sum of the ratings is then used as a "total" attitude toward the concept.

Because the scales mentioned produce numbers that can be analyzed statistically they have been used more often than other self-report procedures.

There are many other self-report procedures some of which have the potential for providing more valid data on attitude than is possible with scales. A simple but effective approach is to ask subjects to respond to open-ended questions such as these: Which sections of mathematics do you like best (least)? Why are you taking mathematics? What makes mathematics easy (difficult) to learn?

The following questions can provide useful insights into the formation of attitudes, change in attitude and the prediction of behaviour: Do you intend to take more mathematics and why? Who helps you with your mathematics at home? There is no doubt that self-reports are an extremely valuable approach to assessing attitude.

Some researchers are however, using scales which have been constructed without proper validation or they use previously constructed scales which are not appropriate. Another problem is that disparate items are sometimes combined to give a single score and this can lead to data being overlooked which are more closely related to the actual attitudes held by the subjects. If however the self-report scales are well constructed they can be very valuable and the advantages of administration and objective scoring are important.

3.5.2 Observation of Behaviour

It is possible to obtain useful and valid information concerning attitudes by observing and recording classroom verbal and non-verbal behaviour. In studies of mathematics attitudes simple checklists could be used to determine the existence and extent of behaviour such as smiling, voluntary responses, doing classwork and helping other pupils. Behaviour such as sitting in the back row in class, being late or absent, being inattentive can also be used to make inferences about attitudes. For younger pupils this approach may be more valid than self-reports.
A possible disadvantage is that the researcher may experience difficulty in proving that the behaviour he has observed is indeed related to attitudes.

3.5.3 Reaction to Structured Stimuli

This method has been used largely by social psychologists to determine attitudes and attitude-related behaviour in relation to prejudice-laden factors. Since opinions about mathematics are often formed emotionally and without basis in fact, mathematics attitudes can be considered to be similar to prejudices. The nature of these beliefs about mathematics could be explored using structured situations. Examples of stimuli which could be used might be pictures of classrooms or even exposure to the normal classroom situation in which a single factor is varied, such as small-group work versus lecture. The pupil could then be questioned or observed to determine the response to viewing or participating in the structured situation.

3.5.4 Performance on Tasks

Information concerning attitudes can also be provided by noting pupils' performance on an "objective" task. Simply by requesting the pupil to do a computation, solve a problem, do a geometry construction, it may be possible to infer the nature of the subject's attitudes. These tasks could be varied from pupil to pupil thus making it possible to discover variations in attitudes towards different types of mathematical content or activity.

3.5.5 Physiological Reactions

Traditionally the physiological reactions used in measuring emotional or attitudinal responses are galvanic skin response, heart rate, blood pressure and breathing depth. There are however other less refined responses which indicate the degree of stress or enjoyment and these could be useful and sufficiently accurate indications of attitude for use in classroom research.

Is the pupil physically restless, agitated or calm in mathematics lessons? Is the pupil aggressive? Does the pupil try to avoid certain tasks or behave in a certain manner when approaching tasks?

If one kept a record of these physiological responses together with the types of situations in which they occurred, useful information could be provided for the researcher.

Measurement of attitudes at the present time is done almost exclusively through the use of self-report scales. The lack of other approaches to measurement represents an area in obvious need of development. The researcher should firstly consider more common sense, realistic views of assessing attitude and secondly, he should consider more direct observation of individuals rather than groups. Many approaches should be used for the measurement of attitudes in the future and researchers should not consider self-report scales to be the only acceptable way of measuring attitudes.

CHAPTER 4

RESEARCH DESIGN

The research project is comprised of two parts.

Part 1: The determination of the drop-out rate in Mathematics after Standard 7.

Part 2: The implementation of an attitude questionnaire.

4.1 GENERAL AIMS

Part 1

The purpose of this part of the research design was

(i) to determine the present extent of the drop-out rate in Mathematics after it ceases to be compulsory i.e. after Standard 7.

(ii) to determine the extent of the difference in the drop-out rates between boys and girls.

Part 2

The purpose of the second part of the research project was

(i) to determine by means of a modified attitude questionnaire, based on that of C.A. Riedesel and P.C. Burns (1977) the polarity of the attitudes (either positive or negative) that the sample had toward Mathematics.

(ii) to investigate changes in attitudes (by cross-sectional developmental research) as possible or partial reasons for the drop-out rate.

(iii) to investigate differences in attitudes between the boys and girls of the sample as possible reasons for the differences in the drop-out rate between the boys and girls.

4.2 THE SAMPLE

The sample comprised English-speaking pupils from five High Schools in East London, three of which are co-educational and the other two, single-sex schools. The schools are all of the middle and upper socio-economic group with similar language and cultural backgrounds. They are all government High Schools and the children involved in the study all received their instruction through the medium of English. The determination of the drop-out rate involved all the pupils from Standards 6 to 10 in each of the five schools. The attitude questionnaire was only administered to the Standard 6 and 7 pupils of the schools involved. The sample for the attitude questionnaire was made up as follows:

	STANDARD			
	6		7	
School	Boys	Girls	Boys	Girls
1.	141		100	
2.		144		112
3.	62	53	47	69
4.	12	22	31	37
5.	59	95	66	89
	274	314	244	307

Sample Total : Boys + Girls = 518 + 621
= 1139

4.3 DETERMINATION OF THE DROP-OUT RATE

In order to determine the drop-out rate in mathematics after Standard 7, it was necessary to determine the percentage of boys and girls (separately) taking mathematics in Standards 8, 9 and 10 in each of the five schools of the sample. The percentage of pupils taking mathematics in Standards 6 and 7 is 100% since the subject is compulsory in these standards. The necessary information was obtained from the schools by requesting the teacher psychologists in each school to complete a form similar to the following:

SCHOOL	Std. 8	Std. 9	Std. 10
Total number of boys in			
Number of boys taking maths.			
Total number of girls in			
Number of girls taking maths.			

From the information supplied, the required percentages were calculated and a graph representing this information was drawn. The graph and results of this section of the survey are recorded in Chapter 1, pages 11, 12 and 13.

4.4 THE ATTITUDE QUESTIONNAIRE

The questionnaire used was of the Likert-type rather than the Thurstone or Semantic Differential type. Ease of construction was the main reason for using this type of questionnaire. Since no standardised South African attitude tests for Mathematics were available, an adaptation of the Riedesel Inventory of Children's Attitudes towards Mathematics (RICATM) was used.

The various items of the Attitude Questionnaire can be grouped in the following way:-

			ITEMS
1.	Overall attitude toward Mathematics	Part A	1
2.	General attitude towards School	Part A	53 - 62

			ITEMS
3.	Specific attitudes toward Mathematics		
(i)	Liking for Mathematics	Part A	7, 12, 22, 25 27, 29, 33, 45, 49.
(ii)	Usefulness of Mathematics	Part A	4, 15, 19, 23, 26, 31, 37, 39, 44, 50.
(iii)	Anxiety concerning Mathematics	Part A	3, 10, 18, 24, 32, 35, 40, 46, 48, 52.
(iv)	Interest in Mathematics	Part A	5, 8, 16, 21, 28, 41.
(v)	Ability and Achievement in Mathematics	Part A	6, 13, 20, 30, 34, 36, 38, 43, 47, 51.
(vi)	Understanding of Mathematics	Part A	9, 14.
(vii)	Preferences	Part A	2, 11, 17, 42.
		Part C	1 - 12.

4. Other Variables

			ITEMS
(i)	Peers	Part B	1 - 5.
(ii)	Methods and Materials	Part B	6 - 14.
(iii)	Family Variables	Part B	15 - 22.

In part A allowance was made for four responses as opposed to the five which occur in the Likert-type questionnaire. Part B and Part C required true or false responses to each question.

A copy of the questionnaire is included in the appendix.

4.5 THE PILOT SURVEY

The attitude questionnaire was administered to a Standard 6 and Standard 7 class in an East London High School not involved in the survey. It was ascertained that the test would take approximately twenty minutes to complete. No problems were encountered by the pilot survey group with regard to comprehension or wording of the questionnaire items. In view of this fact, the questionnaire was then printed in its final form.

4.6 IMPLEMENTATION OF THE QUESTIONNAIRE

The testing was done towards the end of the third quarter of 1983, during August and September. Although the original plan was to go to each school to conduct the testing personally, the Principals of the schools involved felt that it would be more convenient for them if the members of staff did the testing.

In this way testing could be done at a time suitable to the teachers involved and would cause less disruption of the school programme.

Printed instructions were included with the questionnaires for each class and teachers were requested to conduct the testing according to these instructions.

4.7 SCORING

It was decided that only two of the four possible alternatives would be used. Strongly agree and agree were taken as the same response, as were strongly disagree and disagree. Each sentence was considered to be either positive or negative. Totals were obtained for the agree and disagree side for each sentence. The totals for boys and girls in each standard were calculated separately in order to compare the

(i) attitudes of Standard 6 boys and Standard 7 boys;
(ii) attitudes of Standard 6 girls and Standard 7 girls;
(iii) attitudes of Standard 6 boys and Standard 6 girls;
(iv) attitudes of Standard 7 boys and Standard 7 girls.

Chi-squared tests were then done for each of the ninety-six items in each of the above comparison groups. To determine the most significant differences in attitudes for the items, the following levels of significance were chosen:

$p \leqslant 0{,}001$	$(\chi^2 \geqslant 10{,}827)$
$p \leqslant 0{,}01$	$(\chi^2 \geqslant 6{,}635)$
$p \leqslant 0{,}05$	$(\chi^2 \geqslant 3{,}841)$

4.8 EX POST FACTO RESEARCH

In educational research "ex post facto" means "after the fact" or "retrospectively" and refers to studies which investigate possible cause-and-effect relationships by looking at an existing condition and then searching back in time for feasible causal factors. Ex post facto research is therefore a method of extracting possible causes of events which have already occurred and therefore cannot be manipulated by the "investigator".

The present study is an example of ex post facto research. Possible causes for the drop-out rate in Mathematics and for the difference in drop-out rate between boys and girls are sought by looking at their attitudes toward Mathematics.

4.8.1 Two kinds of Design may be identified in Ex post facto Research

(i) Co-relational study, sometimes known as Causal research.

(ii) Causal-comparative research.

A causal study is one which is concerned with identifying the antecedents of a present condition. The value of this type of study lies mainly in its exploratory character as these studies are not always adequate for establishing causal relationships among variables --- they do however, yield measures of association.

In the causal-comparative approach, the investigator attempts to find possible causes for a phenomenon being studied by comparing subjects in whom the variable is present with similar subjects from whom it is absent.

4.8.2 Characteristics of Ex Post Facto Research

(i) The most distinctive characteristic of ex post facto research is that the data are collected after the presumed cause or causes have occurred. The researcher then takes the effect and investigates the data retrospectively in order that causes, relationships or associations may be established.

(ii) Another characteristic of this type of research is in fact also a built-in weakness -- lack of control of the independent variable or variables. The investigator is obliged to take things as they are and attempt to disentangle them.

(iii) By their nature, ex post facto experiments can provide support for a number of different and possibly even contradictory hypotheses. The investigator begins with certain data and attempts to find an interpretation consistent with them; often, however, a number of different interpretations present themselves. Sometimes causal relationships appear to be established purely on the premise that any related event which occurred prior to the phenomena under study is assumed to be its cause. The fact is overlooked that when a relationship is established between two variables, each could be the cause of the other, or both could be caused by some common third factor. The evidence merely illustrates the hypothesis; it does not test it, since hypotheses cannot be tested on the same data from which they were derived.

Although ex post facto designs are very valuable in educational and social research designs, the inability of these designs to incorporate control makes them vulnerable from a scientific point of view and there is the possibility that they could be misleading.

Ex post facto designs should be thought of, not as experiments, but as surveys, useful as sources of hypotheses which could be tested by more conventional experimental methods at a later stage.

4.8.3 Advantages and Disadvantages of Ex Post Facto Research

Some of the advantages and disadvantages have already become obvious in the previous section but will now be examined more explicitly.

Advantages.

(i) Ex post facto research can be used where it is sometimes not possible to use the more rigorous experimental approach.

(ii) Ex post facto research is a valuable exploratory tool in that it supplies information about the nature of the phenomena being studied.

(iii) The improvements in statistical techniques and good methodology have made ex post facto designs more acceptable.

(iv) Where the use of the experimental method would introduce an element of artificiality into the research proceedings, ex post facto research is a more useful method.

(v) Ex post facto research is particularly useful when simple cause-and-effect relationships are being investigated.

(vi) This method does provide a sense of direction and yields a valuable source of hypotheses which can subsequently be tested by the experimental approach.

Disadvantages.

(i) Lack of control is one of the major weaknesses of the ex post facto design in that the researcher is unable to manipulate the independent variable or to randomise his subjects.

(ii) One does not know for sure whether the causative factor has been included or even identified.

(iii) Many factors could be involved rather than a single causative factor.

(iv) Sometimes a certain outcome may result from different causes on different occasions.

(v) Once a relationship has been established, there is the problem of determining which is the cause and which the effect.

(vi) Cause and effect are not necessarily established when two factors are related.

(vii) Classification into dichotomous groups can be a problem.

(viii) Difficulty may be experienced with the interpretation and there is always the danger of the assumption being made that because event A precedes event B, A is the cause of B.

(ix) Conclusions are sometimes based on too limited a sample or number of occurrences.

(x) It can fail to identify the really significant factor or factors, or to recognise that some events have multiple rather than single causes.

(xi) It may be regarded by some as too flexible a method.

(xii) Ex post facto research lacks nullifiability and confirmation.

CHAPTER 5

RESULTS OF THE ATTITUDE QUESTIONNAIRE

Complete details of the results may be consulted in the appendix and only the most significant differences in each comparison-group will be discussed in this chapter.

5.1 A COMPARISON OF THE ATTITUDES OF THE STANDARD 6 AND STANDARD 7 BOYS

The attitudes of the Standard 7 boys appear, from the results, to differ very little from those of the Standard 6 boys.

Part A:

In part A, which involves attitudes toward Mathematics and attitudes towards school in general, a significant difference in attitudes occurs in only two of the sixty-two items.

(i) Whereas 73,6% of the Standard 6 boys indicate that they feel at ease in Mathematics classes, only 60,6% of the Standard 7 boys express the same feeling ($p \leqslant 0{,}05$).

(ii) In Standard 6, 65,6% of the boys feel sure of themselves when doing Mathematics but only 48,5% of the Standard 7 boys feel the same ($p \leqslant 0{,}01$).

Part B:

In part B there is a significant difference in only one item.

(i) In response to the item "We use many materials other than the textbook in our Mathematics class", 33,4% of the Standard 6 boys agree with the statement and only 13,7% of the Standard 7 boys agree ($p \leqslant 0{,}001$).

Part C:

Whereas attitudes towards Mathematics in general appear to be much the same for the two standards, there are a number of differences in their preferences for either algebra or geometry. Significant differences occur in seven of the twelve items in this section.

The most significant of these differences are the following:-

(i) More boys in Standard 7 (46,3%) than in Standard 6 (29,2%) prefer algebra to geometry ($p \leqslant 0{,}001$).

(ii) More Standard 7 boys (53,7%) than Standard 6 boys (37,2%) claim to score higher marks in algebra than geometry ($p \leqslant 0{,}001$).

(iii) Fewer Standard 7 boys (39,8%) than Standard 6 boys (54,4%) find geometry more useful than algebra ($p \leqslant 0{,}001$).

5.2 A COMPARISON OF THE ATTITUDES OF THE STANDARD 6 AND STANDARD 7 GIRLS

In contrast to the very slight, almost negligible, difference in attitudes between the Standard 6 and 7 boys, the picture presented by the Standard 6 and 7 girls is very different.

Part A:

There are significant differences in forty-one of the sixty-

two items in this section. All these items, apart from one, are concerned specifically with attitude towards Mathematics rather than attitude towards school. Twenty of these items are significant at the 0,001 level, eight at the 0,01 level and thirteen at the 0,05 level of significance.
The following were the most significant differences:

(i) Fewer of the Standard 7 girls (73,9%) than Standard 6 girls (86%) indicate a liking for Mathematics ($p \leq 0{,}001$).

(ii) Only 68,4% of the Standard 7 girls agree with the statement "It is fun to work with Mathematics" whereas 81,8% of the Standard 6 girls agree with the statement ($p \leq 0{,}001$).

(iii) A greater percentage of Standard 7 girls (43%) than Standard 6 girls (28%) express an unwillingness to study more Mathematics than is absolutely necessary ($p \leq 0{,}001$).

(iv) Fewer Standard 7 girls (59,3%) than Standard 6 girls (74,2%) have a good feeling about Mathematics ($p \leq 0{,}001$).

(v) Although most of the girls in Standards 6 and 7 feel that Mathematics is necessary in order to get a good job, a smaller percentage of Standard 7's (74,9%) than Standard 6's (87,3%) say this is so ($p \leq 0{,}001$).

(vi) Whereas 74,8% of the Standard 6 girls indicate that they find Mathematics interesting, only 59% of the Standard 7 girls do so ($p \leq 0{,}001$).

(vii) More Standard 7 girls (66,9%) disagree with the statement "I feel calm and confident when doing Mathematics" than Standard 6 girls (50,8%) ($p \leqslant 0,001$).

(viii) Only 46,3% of the Standard 7 girls compared with 61,5% of the Standard 6 girls feel that they are good at doing Mathematics ($p \leqslant 0,001$).

(ix) Most of the girls in both Standards disagree with the statement "Mathematics is not very important to me" but approximately twice as many Standard 7's (29,6%) as Standard 6's (14,6%) agree with the statement ($p \leqslant 0,001$).

(x) A smaller percentage of Standard 7 girls (63,5%) than Standard 6 girls (78%) claim to remember most of the things they learn in mathematics ($p \leqslant 0,001$).

(xi) Whereas 65,6% of the Standard 6 girls indicated that they feel sure of themselves when working at Mathematics, only 48,5% of the Standard 7 girls did ($p \leqslant 0,001$).

Part B:

In part B of the questionnaire significant differences in the responses of the Standard 6 and 7 girls were found in sixteen of the twenty-two items.

The three most significant differences in this section were as follows:-

(i) In Standard 6, 33,4% of the pupils claimed to use many materials other than the textbook and only 13,7% of the Standard 7's did so ($p \leqslant 0,001$). Considering the large difference in the responses of the Standard 6 and 7 boys as well as between the Standard 6 and 7 girls, one cannot help feeling that maybe the word "many" in this item had different meanings for different pupils.

(ii) In Standard 6, 94,3% of the girls agreed with the statement "My mother expects me to do well in Mathematics" whereas in Standard 7 the percentage drops to 75,2% ($p \leq 0,001$).

(iii) Similarly, with regard to their views of their fathers' expectations --- a greater percentage of Standard 6 (90,1%) than Standard 7 (72,6%) girls said that their fathers expected them to do well in Mathematics ($p \leq 0,001$).

Part C:

In part C significant differences occurred in nine of the twelve items.

Of particular note are the following:-

(i) A greater percentage of Standard 7 girls (57,7%) than Standard 6 girls (40,8%) prefer algebra to geometry ($p \leq 0,001$).

(ii) More Standard 7 girls (29,3%) than Standard 6 girls (15,6%) say that geometry makes them nervous and unsure of themselves ($p \leq 0,001$).

(iii) Fewer Standard 7's (66,8%) than Standard 6's (84,7%) agreed with the statement "I usually understand the geometry we do" ($p \leq 0,001$).

5.3 A COMPARISON OF THE ATTITUDES OF THE STANDARD 6 BOYS AND STANDARD 6 GIRLS

Few differences occur in this comparison group.

Part A:

Only eleven of the sixty-two items in part A are significantly different for Standard 6 boys and girls. Interestingly enough, the three most significant differences occur in items which concern school in general and not mathematics.

(i) Whereas 70,1% of the Standard 6 girls indicated that they like school very much, only 51,8% of the Standard 6 boys felt the same ($p \leq 0,001$).

(ii) More girls (63,1%) than boys (46,4%) say they have always enjoyed going to school ($p \leq 0,001$).

(iii) A greater percentage of girls (63,4%) than boys (47,1%) feel relaxed and happy doing schoolwork ($p \leq 0,001$).

Part B:

Five of the twenty-two items in part B show significantly different responses for the boys and girls.

(i) Only 28,7% of the girls agree with the statement "Most of my friends don't do very well in Mathematics". The percentage of boys who agreed with this statement was 43,1% ($p \leq 0,001$).

(ii) Twenty-one percent of the girls felt that they are given too much Mathematics homework and 39,4% of the boys felt the same about the homework ($p \leq 0,001$).

Part C:

Significant differences occurred in eight out of the twelve items concerned with preferences for either algebra or geometry. It would appear that in general, the boys are more positive than the girls with regard to Geometry.

The two most significant items are:-

(i) A smaller percentage of girls (38,9%) than boys (54,4%) say that geometry appears more useful than algebra ($p \leq 0,001$).

(ii) A greater percentage of girls (51%) than boys (37,2%) say that they score higher marks in algebra than geometry ($p \leq 0,001$).

5.4 A COMPARISON OF THE ATTITUDES OF THE STANDARD 7 GIRLS AND STANDARD 7 BOYS

There are considerable differences in the attitudes of the Standard 7 boys and girls.

Part A:

Of the sixty-two items in this group, the responses to forty-three are significantly different for the boys and girls.

All these differences, with the exception of two, concern attitudes toward Mathematics rather than attitudes towards school in general.

Five of the most significant of these differences are as follows:-

(i) In response to the item "It scares me to have to take Mathematics, 30,3% of the girls agreed and only 11,9% of the boys agreed with the statement ($p \leq 0,001$).

(ii) Whereas 42,3% of the girls would like jobs that do not use any Mathematics, only 20,5% of the boys would like such jobs ($p \leq 0{,}001$).

(iii) A greater percentage of girls (66,1%) than boys (48%) preferred to work short, easy problems than long, interesting ones ($p \leq 0{,}001$).

(iv) The majority of boys (80,7%) say that they like to solve new problems. The percentage in the case of girls is 62,2% ($p \leq 0{,}001$).

(v) Boys (85,7%) to a greater extent than girls (69,7%) feel that mathematics helps in other subjects. This seems to be in line with the idea that more boys than girls tend to take subjects which complement Mathematics or in which Mathematics could be useful; subjects such as Physical Science and Technical Drawing.

Part B:

There are only eight of the twenty-two items in this section which have significantly different responses for the boys and girls. Two of the most significant of these are to do with parental expectations.

(i) Whereas 70,7% of the girls say that their friends think Mathematics is important, 84,4% of the boys say the same ($p \leq 0{,}001$).

(ii) A greater percentage of boys (87,7%) than girls (75,2%) say that their mothers expect them to do well in mathematics ($p \leq 0{,}001$).

(iii) More boys (88,9%) than girls (76,2%) say that their fathers expect them to do well in mathematics ($p \leq 0{,}001$).

This is in accord with previous research which shows that parental expectations with regard to Mathematics achievements are higher for sons than for daughters.

Part C:

Seven of the twelve items in this section indicate a significant difference in attitudes between boys and girls. The most significant of these differences concerns the desire to continue with Mathematics after Standard 7.

(i) A higher percentage of boys (93%) would like to continue with Mathematics after Standard 7 than girls (71,3%) ($p \leq 0{,}001$).

This is in accord with the greater drop-out rate amongst girls than boys which was discussed in Chapter 1.

5.5 SUMMARY OF RESULTS

Comparison Group	Part	Number of items having Significantly different responses at each level of significance			Total number of significant items in each part
		p≤0,001	p≤0,01	p≤0,05	
Std. 6 Boys/ Std. 7 Boys	A	0	1	1	2
	B	1	0	0	1
	C	3	3	1	7
Std. 6 Girls/ Std. 7 Girls	A	20	8	13	41
	B	5	2	9	16
	C	6	1	2	9
Std. 6 Boys/ Std. 6 Girls	A	3	1	7	11
	B	2	2	1	5
	C	2	3	3	8
Std. 7 Girls/ Std. 7 Boys	A	19	12	12	43
	B	3	2	3	8
	C	1	5	1	7

C H A P T E R 6

SUMMARY AND CONCLUSIONS

Few differences in attitude occur between the Standard 6 boys and Standard 6 girls. On the whole they appear to have positive attitudes toward mathematics as well as towards school in general. The main differences in this group concern preferences for either algebra or geometry; the girls being more positively disposed towards algebra than geometry.

Even fewer differences are evident between the Standard 6 boys and Standard 7 boys than those in the above-mentioned comparison group. The attitudes of the Standard 7 boys are much the same as those of the Standard 6 boys and generally tend to be positive. Once again the few differences which do occur concern preferences for algebra or geometry. It appears that the Standard 7 boys have somewhat less positive attitudes towards geometry than the Standard 6 boys.

It is in the next two comparison groups that the greatest differences are evident. The Standard 7 girls differ significantly from the Standard 6 girls on the majority (68,75%) of the items on the questionnaire. There is a definite tendency for the Standard 7 girls to have less positive attitudes toward Mathematics than the Standard 6 girls.

The Standard 7 girls differ significantly from the Standard 7 boys on 60,4% of the items on the questionnaire. If one considers only Part A which deals mainly with attitudes toward Mathematics, they differ on almost 70% of the items. The Standard 7 girls' attitudes are distinctly less positive than those of the Standard 7 boys.

Both Standard 6 and 7 girls have less positive attitudes towards geometry than the Standard 6 and 7 boys. Since geometry is usually associated with the ability to visualize spatially, it is possible that the less positive attitude of the girls is associated with the poorer spatial visualization attributed to them.

From the results the following conclusions are made:-

1) Standard 6 boys and Standard 6 girls have positive attitudes toward Mathematics and these attitudes do not differ significantly for the boys and girls.

2) The boys' attitudes toward Mathematics appear to be constant in Standard 6 and Standard 7.

3) Girls' attitudes are much less positive in Standard 7 than in Standard 6. Bearing in mind that the attitude questionnaires were completed by the pupils in September, it would appear that it is during the Standard 7 year and not the Standard 6 year that this change in attitudes occurs. The natural question to ask at this point is "What happens during the Standard 7 year to affect their attitudes ad-

versely?"

Having taught Mathematics for 18 years and being familiar with the Standard 6 and 7 syllabuses, I do not feel that the difference in the level of difficulty between the Standard 6 and Standard 7 work in itself is the only plausible or sufficient reason for the change in the attitudes of the girls.

4) An obvious corrollary follows from what has been said. If the Standard 6 boys and girls have similar attitudes toward Mathematics and those of the boys remain constant in Standard 7 whilst those of the girls deteriorate, there will be a considerable difference between the attitudes of the Standard 7 girls and the Standard 7 boys.

The previous question could then be altered as follows:-

"Why is it that the boys' attitudes are the same in Standards 6 and 7 whilst the girls' attitudes are less positive in Standard 7?"

It is, I believe, not possible to give one causal factor or even a conclusive answer to this question. Drawing from past research, however, one can but suggest a number of possible or likely reasons for the apparent deterioration in the attitudes of the girls and hence also for the difference in attitudes between boys and girls.

(i) Certainly the fact that slightly more abstract mathematical ideas are presented in Standard 7 than previously could be expected to influence attitudes. The fact that girls are known to be less confident about their ability, together with their tendency to attribute failure to internal causes and success to external causes, could make them less able than the boys to cope with the more abstract work.

(ii) Since traditionally girls have been made to feel that Mathematics is a male domain and that they are not really expected to do very well in the subject (parental expectations as well as teacher expectations are lower for girls than boys), when problems are encountered it is easier for them than for the boys to give up and say "I can't do it". They could in fact feel that they have a "legitimate" reason for their lack of perseverance. The message of the world has been that Mathematics is inappropriate for girls. This cannot but affect their attitudes in some way.

(iii) It is also noteworthy that this development of negative attitudes coincides with a period of adolescent emotional instability in girls which usually occurs at a later stage in boys.

(iv) Peer pressure as well as cross-sex influence on different aspects of behaviour become stronger during adolescence. We have seen that male prejudice against girls' engagement in Mathematics exists and that girls believe that it exists --- they accept the stereotype. This would be a definite discouragement to adolescent girls who could begin to be less positive in their attitudes

toward Mathematics as a result.
Luchins (1976) found that women who continue studying Mathematics, receive less attention from their male peers.

(v) Girls are reported to have higher levels of Mathematics anxiety than males. Certainly if one looks at some of the questionnaire items which explicitly express anxiety, one finds significant differences in the attitudes of the Standard 7 girls and Standard 7 boys in each of the following items:-

(a) It scares me to have to take Mathematics ($p \leq 0{,}001$).
(b) It makes me nervous to even think about doing Mathematics ($p \leq 0{,}01$).
(c) Mathematics make me feel worried and confused ($p \leq 0{,}001$).
(d) Mathematics make me feel nervous and uncomfortable ($p \leq 0{,}05$).
(e) I feel at ease in Mathematics classes ($p \leq 0{,}001$).

It must be remembered that girls are more ready to admit anxiety than boys and this could influence the interpretation. If, however, girls do become more anxious about Mathematics than boys, one would expect this anxiety to increase in Standard 7 when the work becomes more difficult or more abstract. This is in fact borne out in the present study where in the above-mentioned "anxiety" items, the Standard 7 girls profess significantly greater anxiety than the Standard 6 girls. The increase in the anxiety level together with the somewhat less stable emotional state could lead to a general deterioration in attitudes toward Mathematics.

(vi) In Standard 7, the pupils become more career-orientated with regard to their subjects than in Standard 6 since it is at the end of the Standard 7 year that subject choices have to be made. Traditionally boys, rather than girls, choose careers which involve Mathematics or in which Mathematics is useful to them. It is significant that Standard 7 girls perceive Mathematics as being less useful to them than the Standard 6 girls do. Boys in both Standards 6 and 7 perceive Mathematics as being very useful to them. Items on which the Standard 7 girls differed significantly from the Standard 6 girls include the following:-

(a) Mathematics is very useful to everyone ($p \leqslant 0{,}001$).

(b) Mathematics is important in everyday life ($p \leqslant 0{,}05$).

(c) You need Mathematics in order to get a good job ($p \leqslant 0{,}001$).

(d) Mathematics is not very important for most people ($p \leqslant 0{,}001$).

(e) Mathematics helps in other subjects ($p \leqslant 0{,}05$).

(f) Mathematics is not very important to me ($p \leqslant 0{,}001$).

It is possible that attitude with regard to the usefulness of Mathematics affects their other attitudes toward Mathematics. It could affect their liking for Mathematics, their interest in the subject, how hard they are prepared to try etc.

(vii) The differential treatment of girls and boys by Mathematics teachers, which has been mentioned in the literature survey, is yet another factor which could affect the attitudes of girls adversely.

With regard to the differential effect of attitude toward Mathematics on the drop-out rate, it seems reasonable to assume that the deterioration in attitudes of the Standard 7 girls is partly responsible for the higher drop-out rate in Mathematics amongst the girls than the boys.
Many of the factors discussed in Chapter 2 which influence the drop-out rate, are also factors which appear to influence attitudes. Since attitudes in turn have an influence on these factors, one must conclude that the difference in the drop-out rate in Mathematics between the boys and girls is the result of a number of interacting factors of which attitude toward Mathematics constitutes only one important facet.

The age at which the girls' attitudes deteriorate in this particular study is consistent with findings that negative attitudes are formed in the first few years of High School. It has been mentioned that Dutton (1968) found Junior High School to be the critical point in the deterioration of attitudes toward Mathematics. From the present study, the Standard 7 year appears to be the crucial one for girls with regard to Mathematics. This has important implications for the Mathematics teacher.

Attitudes formed at Secondary School level appear to be very difficult to change. Programmes which have been put into operation in the U.S.A. to eliminate "maths-anxiety" have not been very successful. Obviously then, the prevention of adverse attitudes would be an easier, more beneficial exercise than that of attempting to change them once they have been adopted. Mathematics teachers need to be aware of this as well as of the importance of the Standard 7 year, for girls in particular. Encouragement, understanding, sympathy and as much individual attention as possible should be given to the girls in order to build up their confidence and maintain the positive attitudes evident in Standard 6. The teacher can also do much to eliminate the "Mathematics-as-a-Male-Domain" myth, not only by avoiding sexism in the teaching of Mathematics but by making it obvious to the girls that his or her expectations of them do not differ from those of the boys. This would include ensuring that the same amount of "wait-time" is given to both boys and girls when answering questions.

CHAPTER 7

SUGGESTIONS FOR FURTHER RESEARCH

In this concluding chapter, a number of suggestions are made for further research.

(i) There is a great need for longitudinal studies which could clarify the nature of attitude formation or change with respect to a given variable. It would be important to select attitude-related factors with solid evidence of their potential as important and generalizable variables in the formation of or change of Mathematics attitudes.

(ii) More research is needed in order to develop a clear understanding of the variables that define the parent-pupil-teacher relationship. This could be done, not by gross comparisons of group means or general attitude scales but rather by measuring a specific attitude aimed, perhaps, at specific triads of pupils, teachers and parents. One could also investigate questions such as the following:-
If the parent has negative attitudes toward Mathematics and the teacher positive attitudes, is the positive attitude of the teacher likely to cancel out the negative effect of the parent, resulting in a positive attitude in the pupil?
Whose attitude has a greater effect on the pupil?

(iii) There is also a need for research designed specifically to explore the nature of attitude improvement or change, including the investigation of factors such as pre-testing, the time of testing, and the age of the subject. There is evidence that attitudes toward Mathematics are formed or rather crystallized in late Primary and early High School years. Is it worth trying to change attitudes before or after this time? What are the most potent agents for change at different age levels?

(iv) There has not been much research done on the effect that Primary School teachers with positive attitudes and high Mathematics ability have on pupils' attitudes.

(v) It would be interesting to find out what effect the introduction of calculators and/or computers would have on the attitudes of the pupils.

(vi) A comparison of the attitudes of the Standard 6 and Standard 7 girls in single-sex schools with those of girls in co-educational schools could prove interesting. Is there any difference in the attitudes of the girls in these two groups? If there is a difference in attitudes, is this difference entirely due to the presence of the boys in the classroom, the reluctance of the girls to "compete" with boys in a "male domain" or perhaps the differential treatment of boys and girls by the Mathematics teacher.

(vii) If one could identify those attitudes which are resistant to change and those that are not, is this factor related to the rate at which attitudes form? A difficult project to implement, but one which could prove valuable and interesting, would be that of investigating whether an attitude toward Mathematics which is formed gradually, is more resistant to change than one which is formed quickly.

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APPENDIX 1

INSTRUCTIONS TO TEACHERS

1. Please ensure that pupils complete the information at the top of the questionnaire. i.e. Sex, Date of test, Age in years (note: 14 years 11 months = 14 years) and School standard.

2. It should be stressed that this is not a test.

3. Pupils should not write their names on the questionnaires.

4. It should be possible for pupils to complete the questionnaire in ± 20 minutes.

5. Please allow all pupils to start at the same time.

6. Please do not permit discussion by pupils during the allocated time.

7. If any problems were experienced in the administering of the questionnaire, please jot these down and hand in with the completed questionnaires.

Thank you very much for your co-operation.

E.J. Oberholster

APPENDIX 2.

I

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Boys

Std 6 / Std. 7.

+	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

P A R T A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

SENTENCE	Agree		Disagree		χ^2
	Std 6 Boys	Std 7 Boys	Std. 6 Boys	Std 7 Boys	
1. I like mathematics.	239	215	35	29	0,09
2. I'd rather work a short easy problem than a long interesting one.	138	117	136	127	0,30
3. It scares me to have to take mathematics.	30	29	244	215	0,11
4. Mathematics is very useful to everyone.	259	223	15	21	1,96
5. Sometimes I work extra mathematics problems.	123	90	151	154	3,42
6. Mathematics is easy for me.	158	135	116	109	0,29
7. It's fun to work with mathematics.	222	199	52	45	0,02
8. I would like a job that doesn't use any mathematics.	76	50	198	194	3,68
9. I usually understand what we are talking about in mathematics class.	232	216	42	28	1,64
10. It makes me nervous to even think about doing mathematics.	20	27	254	217	2,22
11. I like to solve new problems in mathematics.	219	197	55	47	0,05
12. I don't like to study Mathematics.	75	68	199	176	0,02
13. I have trouble with some of the terms and symbols used in mathematics.	176	167	98	77	1,02
14. No matter how hard I try, I cannot understand mathematics.	34	26	240	218	0,39
15. Mathematics is important in everyday life.	258	224	16	20	1,11
16. I am more interested in mathematics than in most other school subjects.	104	102	170	142	0,80

I

	SENTENCE	Agree		Disagree		χ^2
		Std. 6 Boys	Std. 7 Boys	Std 6 Boys	Std 7 Boys	
17.	I am not willing to study mathematics any more than I have to do.	82	76	192	168	0,09
18.	I feel relaxed and happy when working with numbers.	169	170	105	74	3,65
19.	There is very little need for mathematics in most jobs.	18	23	256	221	1,45
20.	My marks in mathematics have usually been lower than my marks in other school subjects.	105	90	169	154	0,11
21.	I think that mathematics is a very dull subject.	32	30	242	214	0,05
22.	I have always enjoyed mathematics.	185	162	89	82	0,07
23.	Mathematics is not very important for most people.	51	61	223	183	3,12
24.	Mathematics makes me feel worried and confused.	52	46	222	198	0,00
25.	I have a good feeling about mathematics.	201	181	73	63	0,05
26.	You need mathematics in order to get a good job.	253	214	21	30	3,12
27.	I don't like mathematics very much.	66	59	208	185	0,00
28.	Mathematics is very interesting to me.	192	179	82	65	0,69
29.	I have a bad feeling about mathematics.	44	39	230	205	0,00
30.	I often think "I can't do it" when a mathematics problem seems hard.	154	136	120	108	0,01
31.	Most of what we learn in mathematics class is not useful.	47	52	227	192	1,44
32.	I feel calm and confident when doing mathematics.	175	157	99	87	0,01
33.	I have never enjoyed studying mathematics.	62	56	212	188	0,01
34.	Word problems in mathematics have always been difficult for me.	105	109	169	135	2,15
35.	Mathematics makes me feel nervous and uncomfortable.	52	44	222	200	0,08
36.	My mathematics marks have usually been higher than my marks in other subjects.	131	131	143	113	1,78
37.	Mathematics helps in other subjects.	224	209	50	35	1,43
38.	I am good at working mathematics.	174	146	100	98	0,74

I

SENTENCE	Agree		Disagree		χ^2
	Std. 6 Boys	Std 7. Boys	Std. 6 Boys	Std 7. Boys	
39. To most people mathematics is less important than other subjects.	151	121	123	123	1,58
40. I feel at ease in mathematics classes.	189	189	85	55	x 4,71
41. I find mathematics very boring.	39	35	235	209	0,00
42. I would like to belong to a maths. club.	98	83	176	161	0,17
43. I am able to work mathematics without trying very hard.	113	105	161	139	0,17
44. Mathematics is not very important to me.	30	41	244	203	3,74
45. I just don't like mathematics.	34	39	240	205	1,36
46. I am not frightened or afraid of mathematics.	232	199	42	45	0,90
47. I feel I could do better in mathematics if I tried harder.	255	225	19	19	0,14
48. I feel anxious when someone talks about mathematics.	67	59	207	185	0,01
49. Mathematics is one of my favourite subjects.	156	154	118	90	2,05
50. Mathematics is a very worthwhile and necessary subject.	257	224	17	20	0,77
51. I remember most of the things I learn in mathematics.	210	189	64	55	0,05
52. I feel sure of myself when working mathematics.	195	146	79	98	⊕ 7,37
53. I like school very much.	142	137	132	107	0,97
54. I don't like to study school subjects.	109	99	165	145	0,03
55. I have never enjoyed studying.	123	113	151	131	0,11
56. I have always enjoyed going to school.	127	123	147	121	0,85
57. There is very little need for going to school for most jobs.	15	7	259	237	2,16
58. Schoolwork makes me feel worried and confused.	64	42	210	202	2,49
59. I feel relaxed and happy when doing schoolwork.	124	134	145	110	3,17
60. School is very interesting to me.	193	179	81	65	0,55
61. I think that school is very dull.	51	54	223	140	0,49
62. You need to go to school in order to get a good job.	269	238	5	6	0,25

GEM INSTANT PRINT

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

SENTENCE	True		False		χ^2
	Std 6	Std 7	Std 6	Std 7	
1. I like mathematics because my friends do.	1	3	273	241	1,26
2. Most of my friends don't do very well in mathematics.	118	94	156	150	1,10
3. My friends think mathematics is important.	213	206	61	38	3,74
4. Mathematics is not a favourite subject of most of my friends.	182	158	92	86	0,16
5. I do not like mathematics because my friends do not like it.	7	5	267	239	0,15
6. We do a lot of small-group work in mathematics classes.	34	27	240	217	0,22
7. I would like more class discussion in mathematics than we have now.	198	178	76	66	0,03
8. I think we have too much homework in mathematics.	108	85	166	159	1,16
9. The homework we have is usually interesting.	179	151	95	93	0,66
10. I like to use objects and other real materials when studying mathematics.	178	144	96	100	1,94
11. We use many materials other than the textbook in our mathematics class.	87	38	187	206	ǂ 18.65
12. I don't like the textbook we use in mathematics.	58	57	216	187	0,36
13. I think our mathematics books are too difficult.	48	46	226	198	0,16
14. I think our mathematics books are too easy.	35	33	239	211	0,06
15. My father likes mathematics.	202	178	72	66	0,04
16. My mother likes mathematics.	152	127	122	117	0,61
17. My mother expects me to pass in mathematics.	265	230	9	14	1,83
18. My father expects me to pass in mathematics.	265	235	9	9	0,06
19. My mother expects me to do well in mathematics.	252	214	22	30	2,60
20. My father expects me to do well in mathematics.	249	217	25	27	0,54
21. My mother helps me with my mathematics homework.	50	31	224	213	3,01
22. My father helps me with my mathematics homework.	85	64	157	180	1,45

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

SENTENCE	True		False		χ^2
	Std. 6	Std. 7	Std. 6	Std. 7	
1. I prefer Algebra to Geometry.	80	113	194	131	‡ 16,17
2. Geometry is more interesting than Algebra.	185	137	89	107	⊕ 7,10
3. Geometry makes me feel nervous and unsure of myself.	41	45	233	149	1,13
4. I score higher marks in Algebra than in Geometry.	102	131	172	113	* 14,13
5. I enjoy doing Geometry.	215	179	59	65	1,85
6. Geometry appears to be more useful than Algebra.	149	47	125	147	* 11,07
7. I enjoy Algebra and Geometry equally.	99	104	175	140	2,28
8. I cannot see the purpose of doing Algebra.	86	62	188	182	2,26
9. Algebra is easier than Geometry.	86	108	188	136	⊕ 9,13
10. I usually understand the Geometry we do.	241	192	33	52	⊕ 8,08
11. I usually understand the Algebra we do.	189	186	85	58	3,40
12. I should like to continue with mathematics after Standard 7.	238	227	36	17	x 5,35

II

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Girls

Std. 6 / Std 7

ǂ	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

	SENTENCE	Agree		Disagree		χ^2
		Std 6 girls	Std 7 girls	Std 6 girls	Std 7 girls	
1.	I like mathematics.	270	227	44	80	ǂ 14,10
2.	I'd rather work a short easy problem than a long interesting one.	183	203	131	104	x 4,06
3.	It scares me to have to take mathematics.	61	93	253	214	⊕ 9,83
4.	Mathematics is very useful to everyone.	292	260	22	47	ǂ 10,84
5.	Sometimes I work extra mathematics problems.	145	122	169	185	2,63
6.	Mathematics is easy for me.	182	150	132	157	x 5,17
7.	It's fun to work with mathematics.	257	210	57	97	ǂ 15,04
8.	I would like a job that doesn't use any mathematics.	96	130	218	177	⊕ 9,27
9.	I usually understand what we are talking about in mathematics class.	266	237	48	70	x 5,70
10.	It makes me nervous to even think about doing mathematics.	35	65	279	242	ǂ 11,55
11.	I like to solve new problems in mathematics.	234	191	80	116	ǂ 10,89
12.	I don't like to study Mathematics.	83	105	231	202	x 4,44
13.	I have trouble with some of the terms and symbols used in mathematics.	178	212	136	95	⊕ 10,16
14.	No matter how hard I try, I cannot understand mathematics.	42	74	272	233	ǂ 11,76
15.	Mathematics is important in everyday life.	286	263	28	44	x 4,44
16.	I am more interested in mathematics than in most other school subjects.	131	112	183	195	1,79

II

SENTENCE	Agree		Disagree		χ^2
	Std 6 girls	Std.7 girls	Std6 girls	Std7 girls	
17. I am not willing to study mathematics any more than I have to do.	88	132	226	175	‡ 15,21
18. I feel relaxed and happy when working with numbers.	205	181	109	126	2,64
19. There is very little need for mathematics in most jobs.	29	38	285	269	1,59
20. My marks in mathematics have usually been lower than my marks in other school subjects.	96	128	218	179	⊕ 8,33
21. I think that mathematics is a very dull subject.	37	67	277	240	‡ 11,22
22. I have always enjoyed mathematics.	223	178	91	129	‡ 11,54
23. Mathematics is not very important for most people.	80	120	234	187	‡ 13,17
24. Mathematics makes me feel worried and confused.	68	100	246	207	⊕ 9,38
25. I have a good feeling about mathematics.	233	182	81	125	‡ 15,59
26. You need mathematics in order to get a good job.	274	230	40	77	‡ 15,47
27. I don't like mathematics very much.	85	115	229	192	⊕ 7,67
28. Mathematics is very interesting to me.	235	181	79	126	‡ 17,71
29. I have a bad feeling about mathematics.	49	82	265	225	‡ 11,50
30. I often think "I can't do it" when a mathematics problem seems hard.	185	197	129	110	1,81
31. Most of what we learn in mathematics class is not useful.	51	75	263	232	× 6.44
32. I feel calm and confident when doing mathematics.	210	156	104	151	‡ 16,55
33. I have never enjoyed studying mathematics.	71	96	243	211	× 5,92
34. Word problems in mathematics have always been difficult for me.	148	171	166	136	× 4,56
35. Mathematics makes me feel nervous and uncomfortable.	58	78	256	229	× 4,37
36. My mathematics marks have usually been higher than my marks in other subjects.	169	129	145	178	⊕ 8,66
37. Mathematics helps in other subjects.	243	214	71	93	× 4,71
38. I am good at working mathematics.	193	142	121	165	‡ 14,46

GEM INSTANT PRINT

SENTENCE	Agree		Disagree		χ^2
	Std6 girls	Std7 girls	Std6 girls	Std7 girls	
39. To most people mathematics is less important than other subjects.	177	191	137	116	2,20
40. I feel at ease in mathematics classes.	231	186	83	121	* 11,86
41. I find mathematics very boring.	53	73	261	234	x 4,57
42. I would like to belong to a maths. club.	111	103	203	204	0,22
43. I am able to work mathematics without trying very hard.	101	93	213	214	0,25
44. Mathematics is not very important to me.	46	91	268	216	* 20,29
45. I just don't like mathematics.	59	90	255	217	⊕ 9,43
46. I am not frightened or afraid of mathematics.	247	225	67	82	2,46
47. I feel I could do better in mathematics if I tried harder.	282	277	32	30	0,03
48. I feel anxious when someone talks about mathematics.	96	90	218	217	0,12
49. Mathematics is one of my favourite subjects.	187	165	127	142	2,13
50. Mathematics is a very worthwhile and necessary subject.	285	263	29	44	x 3,89
51. I remember most of the things I learn in mathematics.	245	195	69	112	* 15,82
52. I feel sure of myself when working mathematics.	206	149	108	158	* 18,47
53. I like school very much.	220	198	94	109	2,14
54. I don't like to study school subjects.	109	111	205	196	0,14
55. I have never enjoyed studying.	125	109	189	198	1,23
56. I have always enjoyed going to school.	198	173	116	134	2,90
57. There is very little need for going to school for most jobs.	14	9	300	298	1,02
58. Schoolwork makes me feel worried and confused.	58	67	256	240	1,09
59. I feel relaxed and happy when doing schoolwork.	196	182	118	125	0,64
60. School is very interesting to me.	239	229	75	78	0,14
61. I think that school is very dull.	41	59	273	248	x 4,36
62. You need to go to school in order to get a good job.	307	303	7	4	0,77

II

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false. Girls

	SENTENCE	True		False		χ^2
		Std 6	Std 7	Std 6	Std 7	
1.	I like mathematics because my friends do.	2	0	312	307	1,96
2.	Most of my friends don't do very well in mathematics.	90	131	224	176	‡ 13,27
3.	My friends think mathematics is important.	247	217	67	90	x 5,23
4.	Mathematics is not a favourite subject of most of my friends.	187	200	127	107	2,07
5.	I do not like mathematics because my friends do not like it.	5	2	309	305	1,23
6.	We do a lot of small-group work in mathematics classes.	32	49	282	258	x 4,56
7.	I would like more class discussion in mathematics than we have now.	194	197	120	110	0,38
8.	I think we have too much homework in mathematics.	66	74	248	233	0,85
9.	The homework we have is usually interesting.	230	184	84	123	‡ 12,38
10.	I like to use objects and other real materials when studying mathematics.	202	154	112	148	⊕ 10,03
11.	We use many materials other than the textbook in our mathematics class.	105	42	209	265	‡ 33,54
12.	I don't like the textbook we use in mathematics.	101	70	213	237	⊕ 6,82
13.	I think our mathematics books are too difficult.	57	81	257	226	x 6,09
14.	I think our mathematics books are too easy.	46	29	268	278	x 3,76
15.	My father likes mathematics.	244	213	70	94	x 5,54
16.	My mother likes mathematics.	171	143	143	164	x 3,86
17.	My mother expects me to pass in mathematics.	296	272	18	35	x 6,39
18.	My father expects me to pass in mathematics.	299	277	15	30	x 5,76
19.	My mother expects me to do well in mathematics.	275	231	39	76	‡ 15,65
20.	My father expects me to do well in mathematics.	283	234	31	73	‡ 21,53
21.	My mother helps me with my mathematics homework.	66	42	248	265	x 5,82
22.	My father helps me with my mathematics homework.	113	93	201	214	2,27

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false. Girls

	SENTENCE	True		False		χ^2
		Std 6	Std 7	Std 6	Std 7	
1.	I prefer Algebra to Geometry.	128	177	186	130	‡ 17,72
2.	Geometry is more interesting than Algebra.	177	132	137	175	‡ 11,10
3.	Geometry makes me feel nervous and unsure of myself.	49	40	265	217	F 16,80
4.	I score higher marks in Algebra than in Geometry.	160	185	154	122	5,44
5.	I enjoy doing Geometry.	234	193	75	114	‡ 12,87
6.	Geometry appears to be more useful than Algebra.	122	94	192	213	X 4,64
7.	I enjoy Algebra and Geometry equally.	147	120	167	187	3,78
8.	I cannot see the purpose of doing Algebra.	89	70	225	237	2,50
9.	Algebra is easier than Geometry.	123	161	191	146	‡ 11,02
10.	I usually understand the Geometry we do.	266	205	48	102	F 27,27
11.	I usually understand the Algebra we do.	241	225	73	82	0,44
12.	I should like to continue with mathematics after Standard 7.	252	214	62	88	⊕ 6,74

III

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Standard 6

Boys / Girls

Sex:	Boy	Girl
Date of test:	1983	
Age:	years	
School Standard:	6	7

‡	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

	SENTENCE	Agree		Disagree		χ^2
		Girls	Boys	Girls	Boys	
1.	I like mathematics.	270	239	44	35	0,14
2.	I'd rather work a short easy problem than a long interesting one.	183	138	131	136	x 3,70
3.	It scares me to have to take mathematics.	61	30	253	244	⊕ 8,04
4.	Mathematics is very useful to everyone.	242	254	22	15	0,58
5.	Sometimes I work extra mathematics problems.	145	123	169	151	0,10
6.	Mathematics is easy for me.	182	158	132	116	0,01
7.	It's fun to work with mathematics.	257	222	57	52	0,07
8.	I would like a job that doesn't use any mathematics.	96	76	218	198	0,57
9.	I usually understand what we are talking about in mathematics class.	266	232	48	42	0,00
10.	It makes me nervous to even think about doing mathematics.	35	20	279	254	2,55
11.	I like to solve new problems in mathematics.	234	219	80	55	2,42
12.	I don't like to study Mathematics.	83	75	231	199	0,66
13.	I have trouble with some of the terms and symbols used in mathematics.	178	176	136	98	3,48
14.	No matter how hard I try, I cannot understand mathematics.	42	34	272	240	0,12
15.	Mathematics is important in everyday life.	286	258	28	16	2,00
16.	I am more interested in mathematics than in most other school subjects.	131	104	183	170	0,86

SENTENCE	Agree		Disagree		χ^2
	Girls	Boys	Girls	Boys	
17. I am not willing to study mathematics any more than I have to do.	88	82	226	192	0,26
18. I feel relaxed and happy when working with numbers.	205	169	109	105	0,82
19. There is very little need for mathematics in most jobs.	29	18	285	256	1,41
20. My marks in mathematics have usually been lower than my marks in other school subjects.	96	105	218	169	x 3,90
21. I think that mathematics is a very dull subject.	37	32	277	242	0,00
22. I have always enjoyed mathematics.	223	185	91	89	0,84
23. Mathematics is not very important for most people.	80	51	234	223	x 3,98
24. Mathematics makes me feel worried and confused.	68	52	246	222	0,65
25. I have a good feeling about mathematics.	233	201	81	73	0,05
26. You need mathematics in order to get a good job.	274	253	40	21	x 4,05
27. I don't like mathematics very much.	85	66	229	208	0,68
28. Mathematics is very interesting to me.	235	192	79	82	1,67
29. I have a bad feeling about mathematics.	49	44	265	230	0,02
30. I often think "I can't do it" when a mathematics problem seems hard.	185	154	129	120	0,44
31. Most of what we learn in mathematics class is not useful.	51	47	263	227	0,09
32. I feel calm and confident when doing mathematics.	210	175	104	99	0,59
33. I have never enjoyed studying mathematics.	71	62	243	212	0,00
34. Word problems in mathematics have always been difficult for me.	148	105	166	169	x 4,64
35. Mathematics makes me feel nervous and uncomfortable.	58	52	256	222	0,03
36. My mathematics marks have usually been higher than my marks in other subjects.	169	131	145	143	2,12
37. Mathematics helps in other subjects.	243	224	71	50	1,70
38. I am good at working mathematics.	193	174	121	100	0,26

SENTENCE	Agree		Disagree		χ^2
	Girls	Boys	Girls	Boys	
39. To most people mathematics is less important than other subjects.	177	151	137	123	0,09
40. I feel at ease in mathematics classes.	231	189	83	85	1,51
41. I find mathematics very boring.	53	34	261	235	0,78
42. I would like to belong to a maths. club.	111	98	203	176	0,01
43. I am able to work mathematics without trying very hard.	101	113	213	161	x 5,24
44. Mathematics is not very important to me.	46	30	268	244	1,78
45. I just don't like mathematics.	59	34	255	240	x 4,48
46. I am not frightened or afraid of mathematics.	247	232	67	42	3,50
47. I feel I could do better in mathematics if I tried harder.	282	255	32	19	1,96
48. I feel anxious when someone talks about mathematics.	96	67	218	207	2,74
49. Mathematics is one of my favourite subjects.	187	156	127	118	0,41
50. Mathematics is a very worthwhile and necessary subject.	285	257	29	17	1,86
51. I remember most of the things I learn in mathematics.	245	210	69	64	0,16
52. I feel sure of myself when working mathematics.	206	195	108	74	2,09
53. I like school very much.	220	142	94	132	‡ 20,57
54. I don't like to study school subjects.	109	104	205	165	1,61
55. I have never enjoyed studying.	125	123	189	151	1,55
56. I have always enjoyed going to school.	198	127	116	147	‡ 16,52
57. There is very little need for going to school for most jobs.	14	15	300	259	0,32
58. Schoolwork makes me feel worried and confused.	58	64	256	210	2,13
59. I feel relaxed and happy when doing schoolwork.	196	124	118	145	‡ 13,73
60. School is very interesting to me.	239	193	75	81	2,42
61. I think that school is very dull.	41	51	273	223	3,42
62. You need to go to school in order to get a good job.	307	269	7	5	0,12

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		Girls	Boys	Girls	Boys	
1.	I like mathematics because my friends do.	2	1	312	273	0,21
2.	Most of my friends don't do very well in mathematics.	90	118	224	156	† 13,3
3.	My friends think mathematics is important.	247	213	67	61	0,07
4.	Mathematics is not a favourite subject of most of my friends.	187	182	127	92	2,45
5.	I do not like mathematics because my friends do not like it.	5	7	309	267	0,68
6.	We do a lot of small-group work in mathematics classes.	32	34	282	240	0,72
7.	I would like more class discussion in mathematics than we have now.	194	148	120	76	⊕ 7,23
8.	I think we have too much homework in mathematics.	66	108	248	166	† 23,8
9.	The homework we have is usually interesting.	230	179	84	95	x 4,33
10.	I like to use objects and other real materials when studying mathematics.	202	178	112	96	0,03
11.	We use many materials other than the textbook in our mathematics class.	105	87	209	187	0,19
12.	I don't like the textbook we use in mathematics.	101	58	213	216	⊕ 8,97
13.	I think our mathematics books are too difficult.	57	48	257	226	0,04
14.	I think our mathematics books are too easy.	46	35	268	239	0,23
15.	My father likes mathematics.	244	202	70	72	1,27
16.	My mother likes mathematics.	171	152	143	122	0,06
17.	My mother expects me to pass in mathematics.	296	265	18	9	2,00
18.	My father expects me to pass in mathematics.	299	265	15	9	0,83
19.	My mother expects me to do well in mathematics.	275	252	39	22	3,03
20.	My father expects me to do well in mathematics.	283	249	31	25	0,10
21.	My mother helps me with my mathematics homework.	66	50	248	224	0,71
22.	My father helps me with my mathematics homework.	113	85	201	189	1,62

P A R T C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		Girls	Boys	Girls	Boys	
1.	I prefer Algebra to Geometry.	128	80	186	194	⊕ 8,56
2.	Geometry is more interesting than Algebra.	177	185	137	89	⊕ 7,64
3.	Geometry makes me feel nervous and unsure of myself.	49	41	265	233	0,05
4.	I score higher marks in Algebra than in Geometry.	160	102	154	172	* 11,16
5.	I enjoy doing Geometry.	239	215	75	54	0,46
6.	Geometry appears to be more useful than Algebra.	122	149	192	125	* 14,20
7.	I enjoy Algebra and Geometry equally.	147	99	167	175	⊕ 6,86
8.	I cannot see the purpose of doing Algebra.	89	86	225	188	0,65
9.	Algebra is easier than Geometry.	123	86	191	188	x 3,87
10.	I usually understand the Geometry we do.	266	241	48	33	1,30
11.	I usually understand the Algebra we do.	241	189	73	85	x 4,50
12.	I should like to continue with mathematics after Standard 7.	252	238	62	36	x 4,60

IV

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Standard 7

Boys / Girls

ǂ	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

SENTENCE	Agree		Disagree		χ^2
	Girls	Boys	Girls	Boys	
1. I like mathematics.	227	215	80	29	ǂ 17,21
2. I'd rather work a short easy problem than a long interesting one.	203	117	104	127	ǂ 18,44
3. It scares me to have to take mathematics.	93	29	214	215	ǂ 26,7
4. Mathematics is very useful to everyone.	260	223	47	21	x 5,6
5. Sometimes I work extra mathematics problems.	122	90	185	154	0,47
6. Mathematics is easy for me.	150	135	157	109	2,28
7. It's fun to work with mathematics.	210	149	97	45	ǂ 12,24
8. I would like a job that doesn't use any mathematics.	130	50	177	194	ǂ 29,52
9. I usually understand what we are talking about in mathematics class.	237	216	70	28	ǂ 11,93
10. It makes me nervous to even think about doing mathematics.	65	27	242	217	⊕ 9,98
11. I like to solve new problems in mathematics.	191	197	116	47	ǂ 22,34
12. I don't like to study Mathematics.	105	68	202	176	2,53
13. I have trouble with some of the terms and symbols used in mathematics.	212	167	95	77	0,024
14. No matter how hard I try, I cannot understand mathematics.	74	26	233	218	ǂ 16,55
15. Mathematics is important in everyday life.	263	224	44	20	x 4,94
16. I am more interested in mathematics than in most other school subjects.	112	102	195	142	1,62

	SENTENCE	Agree		Disagree		χ^2
		Girls	Boys	Girls	Boys	
17.	I am not willing to study mathematics any more than I have to do.	132	76	175	168	⊕ 8,12
18.	I feel relaxed and happy when working with numbers.	181	170	126	74	⊕ 6,75
19.	There is very little need for mathematics in most jobs.	38	23	269	221	1,20
20.	My marks in mathematics have usually been lower than my marks in other school subjects.	128	90	179	154	1,31
21.	I think that mathematics is a very dull subject.	67	30	240	214	⊕ 8,51
22.	I have always enjoyed mathematics.	178	162	129	82	× 4,07
23.	Mathematics is not very important for most people.	120	61	187	183	ǂ 12,23
24.	Mathematics makes me feel worried and confused.	100	46	207	198	ǂ 13,14
25.	I have a good feeling about mathematics.	182	181	125	63	ǂ 13,42
26.	You need mathematics in order to get a good job.	230	214	77	30	ǂ 14,20
27.	I don't like mathematics very much.	115	59	142	185	ǂ 11,09
28.	Mathematics is very interesting to me.	181	174	126	65	ǂ 12,45
29.	I have a bad feeling about mathematics.	82	39	225	205	⊕ 9,13
30.	I often think "I can't do it" when a mathematics problem seems hard.	197	136	110	108	× 4,04
31.	Most of what we learn in mathematics class is not useful.	75	52	232	192	0,75
32.	I feel calm and confident when doing mathematics.	156	157	151	87	⊕ 10,14
33.	I have never enjoyed studying mathematics.	96	56	211	188	× 4,71
34.	Word problems in mathematics have always been difficult for me.	171	109	136	135	× 6,62
35.	Mathematics makes me feel nervous and uncomfortable.	78	44	229	200	× 4,29
36.	My mathematics marks have usually been higher than my marks in other subjects.	129	131	178	113	⊕ 7,43
37.	Mathematics helps in other subjects.	214	209	93	35	ǂ 17,37
38.	I am good at working mathematics.	142	146	165	98	⊕ 10,05

SENTENCE		Agree		Disagree		χ^2
		Girls	Boys	Girls	Boys	
39.	To most people mathematics is less important than other subjects.	191	121	116	123	⊕ 8,82
40.	I feel at ease in mathematics classes.	186	189	121	55	‡ 17,80
41.	I find mathematics very boring.	73	35	234	209	⊕ 7,68
42.	I would like to belong to a maths. club.	103	83	204	161	0,013
43.	I am able to work mathematics without trying very hard.	43	105	214	134	⊕ 4,58
44.	Mathematics is not very important to me.	41	41	216	203	‡ 12,30
45.	I just don't like mathematics.	40	39	217	205	‡ 13,48
46.	I am not frightened or afraid of mathematics.	225	194	82	45	× 5,24
47.	I feel I could do better in mathematics if I tried harder.	277	225	30	14	0,66
48.	I feel anxious when someone talks about mathematics.	90	59	217	185	1,82
49.	Mathematics is one of my favourite subjects.	165	154	142	90	× 4,40
50.	Mathematics is a very worthwhile and necessary subject.	263	224	44	20	× 4,49
51.	I remember most of the things I learn in mathematics.	195	189	112	55	‡ 12,51
52.	I feel sure of myself when working mathematics.	149	146	158	98	⊕ 6,78
53.	I like school very much.	198	137	109	107	× 3,77
54.	I don't like to study school subjects.	111	49	196	145	1,12
55.	I have never enjoyed studying.	109	113	198	131	× 6,60
56.	I have always enjoyed going to school.	173	123	134	121	1,43
57.	There is very little need for going to school for most jobs.	4	7	298	237	0,19
58.	Schoolwork makes me feel worried and confused.	67	42	240	202	1,82
59.	I feel relaxed and happy when doing schoolwork.	182	134	125	110	1,06
60.	School is very interesting to me.	229	174	78	65	0,11
61.	I think that school is very dull.	59	54	248	190	0,71
62.	You need to go to school in order to get a good job.	303	238	4	6	1,02

P A R T B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		Girls	Boys	Girls	Boys	
1.	I like mathematics because my friends do.	0	3	307	241	3,80
2.	Most of my friends don't do very well in mathematics.	131	94	176	150	0,97
3.	My friends think mathematics is important.	217	206	90	38	‡ 14,4
4.	Mathematics is not a favourite subject of most of my friends.	200	158	107	86	0,92
5.	I do not like mathematics because my friends do not like it.	2	5	305	239	2,12
6.	We do a lot of small-group work in mathematics classes.	49	27	258	217	2,74
7.	I would like more class discussion in mathematics than we have now.	197	178	110	66	× 4,92
8.	I think we have too much homework in mathematics.	74	85	233	159	⊕ 7,63
9.	The homework we have is usually interesting.	184	151	123	93	0,22
10.	I like to use objects and other real materials when studying mathematics.	159	144	148	100	2,87
11.	We use many materials other than the textbook in our mathematics class.	42	38	265	206	0,39
12.	I don't like the textbook we use in mathematics.	70	57	237	187	0,02
13.	I think our mathematics books are too difficult.	81	46	226	198	× 4,35
14.	I think our mathematics books are too easy.	29	33	278	211	2,26
15.	My father likes mathematics.	213	178	94	66	0,84
16.	My mother likes mathematics.	143	127	164	117	1,63
17.	My mother expects me to pass in mathematics.	272	230	35	14	× 5,38
18.	My father expects me to pass in mathematics.	277	235	30	9	⊕ 7,65
19.	My mother expects me to do well in mathematics.	231	214	76	30	‡ 13,59
20.	My father expects me to do well in mathematics.	234	217	73	27	‡ 14,79
21.	My mother helps me with my mathematics homework.	42	31	265	213	0,11
22.	My father helps me with my mathematics homework.	93	64	214	180	1,10

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True: Girls	True: Boys	False: Girls	False: Boys	χ^2
1.	I prefer Algebra to Geometry.	177	113	130	131	⊕ 7,02
2.	Geometry is more interesting than Algebra.	132	137	175	107	⊕ 9,41
3.	Geometry makes me feel nervous and unsure of myself.	90	45	217	199	⊕ 8,69
4.	I score higher marks in Algebra than in Geometry.	185	131	122	113	2,40
5.	I enjoy doing Geometry.	193	179	114	65	⊕ 6,83
6.	Geometry appears to be more useful than Algebra.	94	97	213	147	x 5,01
7.	I enjoy Algebra and Geometry equally.	120	104	187	140	0,70
8.	I cannot see the purpose of doing Algebra.	70	62	237	182	0,51
9.	Algebra is easier than Geometry.	161	108	146	136	3,64
10.	I usually understand the Geometry we do.	205	192	102	52	⊕ 9,58
11.	I usually understand the Algebra we do.	225	186	82	58	0,62
12.	I should like to continue with mathematics after Standard 7.	219	227	88	17	‡ 41,47

V

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Boys

Std 6 / Std 7

+	$p \leq 0,001$
⊕	$p \leq 0,01$
X	$p \leq 0,05$

P A R T A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

	SENTENCE	Agree		Disagree		χ^2
		% Std 6 Boys	% Std 7 Boys	% Std.6 Boys	% Std 7 Boys	
1.	I like mathematics.	87,2	88,1	12,8	11,9	0,09
2.	I'd rather work a short easy problem than a long interesting one.	50,4	48,0	49.6	52,0	0,30
3.	It scares me to have to take mathematics.	10,9	11,9	89,1	88,1	0,11
4.	Mathematics is very useful to everyone.	94,5	91,4	5,5	8,6	1,96
5.	Sometimes I work extra mathematics problems.	44,9	36,9	55,1	63,1	3,42
6.	Mathematics is easy for me.	57,7	55,3	42,3	44,7	0,29
7.	It's fun to work with mathematics.	81,0	81,6	19,0	18,4	0,02
8.	I would like a job that doesn't use any mathematics.	27,7	20,5	72,3	79,5	3,68
9.	I usually understand what we are talking about in mathematics class.	84,7	88,5	15,3	11,5	1,64
10.	It makes me nervous to even think about doing mathematics.	7,3	11,1	92,7	88,9	2,22
11.	I like to solve new problems in mathematics.	79,9	80,7	20,1	19,3	0,05
12.	I don't like to study Mathematics.	27,4	27,9	72,6	72,1	0,02
13.	I have trouble with some of the terms and symbols used in mathematics.	64,2	68,4	35,8	31,6	1,02
14.	No matter how hard I try, I cannot understand mathematics.	12,4	10,7	87,6	89,3	0,39
15.	Mathematics is important in everyday life.	94,2	91,8	5,8	8,2	1,11
16.	I am more interested in mathematics than in most other school subjects.	38,0	41,8	62,0	58,2	0,80

V

	SENTENCE	Agree		Disagree		χ^2
		% Std 6 Boys	% Std 7 Boys	% Std 6 Boys	% Std 7 Boys	
17.	I am not willing to study mathematics any more than I have to do.	29,9	31,1	70,1	68,9	0,09
18.	I feel relaxed and happy when working with numbers.	61,7	69,7	38,3	30,3	3,65
19.	There is very little need for mathematics in most jobs.	6,6	9,4	93,4	90,6	1,45
20.	My marks in mathematics have usually been lower than my marks in other school subjects.	38,3	36,9	61,7	63,1	0,11
21.	I think that mathematics is a very dull subject.	11,7	12,3	88,3	87,7	0,05
22.	I have always enjoyed mathematics.	67,5	66,4	32,5	33,6	0,07
23.	Mathematics is not very important for most people.	18,6	25,0	81,4	75,0	3,12
24.	Mathematics makes me feel worried and confused.	19,0	18,9	81,0	81,1	0,00
25.	I have a good feeling about mathematics.	73,4	74,2	26,6	25,8	0,05
26.	You need mathematics in order to get a good job.	92,3	87,7	7,7	12,3	3,12
27.	I don't like mathematics very much.	24,1	24,2	75,9	75,8	0,00
28.	Mathematics is very interesting to me.	70,1	73,4	29,9	26,6	0,69
29.	I have a bad feeling about mathematics.	16,1	16,0	83,9	84,0	0,00
30.	I often think "I can't do it" when a mathematics problem seems hard.	56,2	55,7	43,8	44,3	0,01
31.	Most of what we learn in mathematics class is not useful.	17,2	21,3	82,8	78,7	1,44
32.	I feel calm and confident when doing mathematics.	63,9	64,3	36,1	35,7	0,01
33.	I have never enjoyed studying mathematics.	22,6	23,0	77,4	77,0	0,01
34.	Word problems in mathematics have always been difficult for me.	38,3	44,7	61,7	55,3	2,15
35.	Mathematics makes me feel nervous and uncomfortable.	19,0	18,0	81,0	82,0	0,02
36.	My mathematics marks have usually been higher than my marks in other subjects.	47,8	53,7	52,2	46,3	1,78
37.	Mathematics helps in other subjects.	81,8	85,7	13,2	14,3	1,43
38.	I am good at working mathematics.	63,5	59,8	36,5	40,2	0,74

$\overline{V}$

SENTENCE	Agree Std 6 Boys	Agree Std 7 Boys	Disagree Std 6 Boys	Disagree Std 7 Boys	χ^2
39. To most people mathematics is less important than other subjects.	55,1	49,6	44,9	50,4	1,53
40. I feel at ease in mathematics classes.	69,0	77,5	31,0	22,5	x 4,71
41. I find mathematics very boring.	14,2	14,3	85,8	85,7	0,00
42. I would like to belong to a maths. club.	35,8	34,0	64,2	66,0	0,17
43. I am able to work mathematics without trying very hard.	41,2	43,0	58,8	57,0	0,17
44. Mathematics is not very important to me.	10,9	16,8	89,1	83,2	3,74
45. I just don't like mathematics.	12,4	16,0	87,6	84,0	1,36
46. I am not frightened or afraid of mathematics.	84,7	81,6	15,3	18,4	0,90
47. I feel I could do better in mathematics if I tried harder.	93,1	92,2	6,9	7,8	0,14
48. I feel anxious when someone talks about mathematics.	24,5	24,2	75,5	75,8	0,01
49. Mathematics is one of my favourite subjects.	56,9	63,1	43,1	36,9	2,05
50. Mathematics is a very worthwhile and necessary subject.	93,8	91,8	6,2	8,2	0,77
51. I remember most of the things I learn in mathematics.	76,6	77,5	23,4	22,5	0,05
52. I feel sure of myself when working mathematics.	71,2	59,8	28,8	40,2	⊕ 7,37
53. I like school very much.	51,8	56,1	48,2	43,9	0,97
54. I don't like to study school subjects.	39,8	40,6	60,2	59,4	0,03
55. I have never enjoyed studying.	44,9	46,3	55,1	53,7	0,11
56. I have always enjoyed going to school.	46,4	50,4	53,6	49,6	0,35
57. There is very little need for going to school for most jobs.	5,5	2,9	94,5	97,1	2,16
58. Schoolwork makes me feel worried and confused.	23,4	17,2	76,6	82,8	2,99
59. I feel relaxed and happy when doing schoolwork.	47,1	54,9	52,9	45,1	3,17
60. School is very interesting to me.	70,4	73,4	29,6	26,6	0,55
61. I think that school is very dull.	18,6	22,1	81,4	77,9	0,99
62. You need to go to school in order to get a good job.	98,2	97,5	1,8	2,5	0,25

V

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True % Std 6	True % Std 7	False % Std 6	False % Std 7	χ^2
1.	I like mathematics because my friends do.	0,4	1,2	99,6	98,8	1,26
2.	Most of my friends don't do very well in mathematics.	43,1	38,5	56,9	61,5	1,10
3.	My friends think mathematics is important.	77,7	84,4	22,3	15,6	3,74
4.	Mathematics is not a favourite subject of most of my friends.	66,4	64,8	33,6	35,2	0,16
5.	I do not like mathematics because my friends do not like it.	2,6	2,0	97,4	98,0	0,15
6.	We do a lot of small-group work in mathematics classes.	12,4	11,1	87,6	88,9	0,22
7.	I would like more class discussion in mathematics than we have now.	72,3	73,0	27,7	27,0	0,03
8.	I think we have too much homework in mathematics.	39,4	34,8	60,6	65,2	1,16
9.	The homework we have is usually interesting.	65,3	61,9	34,7	38,1	0,66
10.	I like to use objects and other real materials when studying mathematics.	65,0	59,0	35,0	41,0	1,94
11.	We use many materials other than the textbook in our mathematics class.	31,8	15,6	68,2	84,4	‡ 18,45
12.	I don't like the textbook we use in mathematics.	21,2	23,4	78,8	76,6	0,32
13.	I think our mathematics books are too difficult.	17,5	18,9	82,5	81,1	0,16
14.	I think our mathematics books are too easy.	12,3	13,5	87,7	86,5	0,42
15.	My father likes mathematics.	73,7	73,0	26,3	27,0	0,04
16.	My mother likes mathematics.	55,5	52,0	44,5	48,0	0,61
17.	My mother expects me to pass in mathematics.	96,7	94,3	3,3	5,7	1,83
18.	My father expects me to pass in mathematics.	96,7	96,3	3,3	3,7	0,06
19.	My mother expects me to do well in mathematics.	92,0	87,7	8,0	12,3	2,60
20.	My father expects me to do well in mathematics.	90,9	88,9	9,1	11,1	0,54
21.	My mother helps me with my mathematics homework.	18,2	12,7	81,8	87,3	3,01
22.	My father helps me with my mathematics homework.	31,0	26,2	69,0	73,8	1,45

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True % Std 6	True % Std 7	False % Std 6	False % Std 7	χ^2
1.	I prefer Algebra to Geometry.	29,2	46,3	70,8	53,7	‡ 16,17
2.	Geometry is more interesting than Algebra.	67,5	56,1	30,5	43,9	⊕ 7,10
3.	Geometry makes me feel nervous and unsure of myself.	15,0	18,4	85,0	81,6	1,13
4.	I score higher marks in Algebra than in Geometry.	37,2	53,7	62,8	46,3	‡ 14,13
5.	I enjoy doing Geometry.	78,5	73,4	21,5	26,6	1,85
6.	Geometry appears to be more useful than Algebra.	54,4	39,8	45,6	60,2	‡ 11,07
7.	I enjoy Algebra and Geometry equally.	36,1	42,7	63,9	57,4	2,22
8.	I cannot see the purpose of doing Algebra.	31,4	25,4	68,6	74,6	2,26
9.	Algebra is easier than Geometry.	31,4	44,3	68,6	55,7	⊕ 9,13
10.	I usually understand the Geometry we do.	88,0	73,7	12,0	76,2	⊕ 8,08
11.	I usually understand the Algebra we do.	69,0	76,2	31,0	23,8	3,40
12.	I should like to continue with mathematics after Standard 7.	86,9	93,0	13,1	7,0	x 5,35

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Girls
Std 6/Std 7

ǂ	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

	SENTENCE	Agree		Disagree		χ^2
		% Std 6 Girls	% Std 7 Girls	% Std 6 Girls	% Std 7 Girls	
1.	I like mathematics.	86,0	73,9	14,0	26,1	ǂ 14,10
2.	I'd rather work a short easy problem than a long interesting one.	58,3	66,1	41,7	33,9	x 4,06
3.	It scares me to have to take mathematics.	19.4	30,3	80,6	69.7	⊕ 9,83
4.	Mathematics is very useful to everyone.	93,0	84.7	7,0	15,3	ǂ 10,94
5.	Sometimes I work extra mathematics problems.	46,2	39.7	53,8	60,3	2,63
6.	Mathematics is easy for me.	58,0	48,9	42,0	51,1	x 5,17
7.	It's fun to work with mathematics.	81,8	68,4	13,2	31.6	ǂ 15,04
8.	I would like a job that doesn't use any mathematics.	30,6	42,3	69,4	57.7	⊕ 9,29
9.	I usually understand what we are talking about in mathematics class.	84.7	77,2	15,3	22,8	x 5,70
10.	It makes me nervous to even think about doing mathematics.	11,1	21,2	88,9	78,8	ǂ 11,55
11.	I like to solve new problems in mathematics.	74.5	62,2	25.5	37.8	ǂ 10,89
12.	I don't like to study Mathematics.	26,4	34,2	73,6	65,8	x 4,44
13.	I have trouble with some of the terms and symbols used in mathematics.	56,7	69,1	43,3	30,9	⊕ 10,16
14.	No matter how hard I try, I cannot understand mathematics.	13,4	24,1	86,6	75,9	ǂ 11,76
15.	Mathematics is important in everyday life.	91,1	85,7	8,9	14,3	x 4,44
16.	I am more interested in mathematics than in most other school subjects.	41,7	36,5	58,3	63,5	1,79

SENTENCE	Agree		Disagree		χ^2
	% Std 6 Girls	% Std 7 Girls	% Std 6 Girls	% Std 7 Girls	
17. I am not willing to study mathematics any more than I have to do.	28,0	43,0	72,0	57,0	ǂ 15,21
18. I feel relaxed and happy when working with numbers.	65,3	59,0	34,7	41,0	2,64
19. There is very little need for mathematics in most jobs.	9,2	12,4	90,8	87,6	1,59
20. My marks in mathematics have usually been lower than my marks in other school subjects.	30,6	41,7	69,4	58,3	⊕ 8,33
21. I think that mathematics is a very dull subject.	11,8	21,8	88,2	78,2	ǂ 11,22
22. I have always enjoyed mathematics.	71,0	58,0	29,0	42,0	ǂ 11,54
23. Mathematics is not very important for most people.	25,5	39,1	74,5	60,9	ǂ 13,17
24. Mathematics makes me feel worried and confused.	21,7	32,6	78,3	67,4	⊕ 9,38
25. I have a good feeling about mathematics.	74,2	59,3	25,8	40,7	ǂ 15,59
26. You need mathematics in order to get a good job.	87,3	74,9	12,7	25,1	ǂ 15,47
27. I don't like mathematics very much.	27,1	37,5	72,9	62,5	⊕ 7,67
28. Mathematics is very interesting to me.	74,8	59,0	25,2	41,0	ǂ 17,71
29. I have a bad feeling about mathematics.	15,6	26,7	84,4	73,3	ǂ 11,50
30. I often think "I can't do it" when a mathematics problem seems hard.	58,9	64,2	41,1	35,8	1,21
31. Most of what we learn in mathematics class is not useful.	16,2	24,4	83,8	75,6	x 6,44
32. I feel calm and confident when doing mathematics.	66,9	50,8	33,1	49,2	ǂ 16,55
33. I have never enjoyed studying mathematics.	22,6	31,3	77,4	68,7	x 5,92
34. Word problems in mathematics have always been difficult for me.	47,1	55,7	52,9	44,3	x 4,56
35. Mathematics makes me feel nervous and uncomfortable.	18,5	25,4	81,5	74,6	x 4,37
36. My mathematics marks have usually been higher than my marks in other subjects.	53,8	42,0	46,2	58,0	⊕ 8,66
37. Mathematics helps in other subjects.	77,4	69,7	22,6	30,3	x 4,71
38. I am good at working mathematics.	61,5	46,3	38,5	53,7	ǂ 14,46

	SENTENCE	Agree		Disagree		χ^2
		% Std 6 Girls	% Std 7 Girls	% Std 6 Girls	% Std 7 Girls	
39.	To most people mathematics is less important than other subjects.	56,4	62,2	43,6	37,8	2,20
40.	I feel at ease in mathematics classes.	73,6	60,6	26,4	39,4	‡ 11,86
41.	I find mathematics very boring.	16,9	23,8	83,1	76,2	x 4,57
42.	I would like to belong to a maths. club.	35,4	33,6	64,6	66,4	0,22
43.	I am able to work mathematics without trying very hard.	32,2	30,3	67,8	69,7	0,25
44.	Mathematics is not very important to me.	14,6	29,6	85,4	70,4	‡ 26,29
45.	I just don't like mathematics.	18,8	29,3	81,2	70,7	⊕ 9,43
46.	I am not frightened or afraid of mathematics.	78,7	73,3	21,3	26,7	2,44
47.	I feel I could do better in mathematics if I tried harder.	89,8	90,2	10,2	9,8	0,03
48.	I feel anxious when someone talks about mathematics.	30,6	29,3	69,4	70,7	0,12
49.	Mathematics is one of my favourite subjects.	59,6	53,7	40,4	46,3	2,13
50.	Mathematics is a very worthwhile and necessary subject.	90,8	85,7	9,2	14,3	x 3,89
51.	I remember most of the things I learn in mathematics.	78,0	63,5	22,0	36,5	‡ 15,82
52.	I feel sure of myself when working mathematics.	65,6	48,5	34,4	51,5	‡ 18,47
53.	I like school very much.	70,1	64,5	29,9	35,5	2,19
54.	I don't like to study school subjects.	34,7	36,2	65,3	63,8	0,14
55.	I have never enjoyed studying.	39,8	35,5	60,2	64,5	1,23
56.	I have always enjoyed going to school.	63,1	56,4	36,9	43,6	2,90
57.	There is very little need for going to school for most jobs.	4,5	2,9	95,5	97,1	1,02
58.	Schoolwork makes me feel worried and confused.	18,5	21,8	81,5	78,2	1,09
59.	I feel relaxed and happy when doing schoolwork.	62,4	59,3	37,6	40,7	0,64
60.	School is very interesting to me.	76,1	74,6	23,9	25,4	0,19
61.	I think that school is very dull.	13,1	19,2	86,9	80,8	x 4,36
62.	You need to go to school in order to get a good job.	97,8	98,7	2,2	1,3	0,77

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		Std 6	Std 7	Std 6	Std 7	
1.	I like mathematics because my friends do.	0,6	0,0	99,4	100	1,96
2.	Most of my friends don't do very well in mathematics.	28,7	42,7	71,3	57,3	‡ 13,29
3.	My friends think mathematics is important.	78,7	70,7	21,3	29,3	x 5,23
4.	Mathematics is not a favourite subject of most of my friends.	59,6	65,1	40,4	34,9	2,07
5.	I do not like mathematics because my friends do not like it.	1,6	0,6	98,4	99,4	1,23
6.	We do a lot of small-group work in mathematics classes.	10,2	16,0	89,8	84,0	x 4,56
7.	I would like more class discussion in mathematics than we have now.	61,8	64,2	38,2	35,8	0,38
8.	I think we have too much homework in mathematics.	21,0	24,1	79,0	75,9	0,85
9.	The homework we have is usually interesting.	73,7	59,9	26,3	40,1	‡ 12,33
10.	I like to use objects and other real materials when studying mathematics.	64,3	51,8	35,7	48,2	⊕ 10,03
11.	We use many materials other than the textbook in our mathematics class.	33,4	13,7	66,6	86,3	‡ 33,54
12.	I don't like the textbook we use in mathematics.	32,2	22,8	67,8	77,2	⊕ 6,22
13.	I think our mathematics books are too difficult.	18,2	26,4	81,8	73,6	x 6,09
14.	I think our mathematics books are too easy.	14,6	9,4	85,4	90,6	x 3,96
15.	My father likes mathematics.	77,7	69,4	22,3	30,6	x 5,54
16.	My mother likes mathematics.	54,5	46,6	45,5	53,4	x 3,86
17.	My mother expects me to pass in mathematics.	94,3	88,6	5,7	11,4	x 6,39
18.	My father expects me to pass in mathematics.	95,2	90,2	4,8	9,8	x 5,76
19.	My mother expects me to do well in mathematics.	87,6	75,2	12,4	24,3	‡ 15,65
20.	My father expects me to do well in mathematics.	90,1	76,2	9,9	23,2	‡ 21,53
21.	My mother helps me with my mathematics homework.	21,0	13,7	79,0	86,3	x 5,82
22.	My father helps me with my mathematics homework.	36,0	30,3	64,0	69,7	2,27

VI

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		Std 6	Std 7	Std 6	Std 7	
1.	I prefer Algebra to Geometry.	40,8	57,7	59,2	42,3	‡ 17,72
2.	Geometry is more interesting than Algebra.	56,4	43,0	43,6	57,0	‡ 11,10
3.	Geometry makes me feel nervous and unsure of myself.	15,6	29,3	84,4	70,7	‡ 16,90
4.	I score higher marks in Algebra than in Geometry.	51,0	60,3	49,0	39,7	x 5,44
5.	I enjoy doing Geometry.	76,1	62,9	23,9	37,1	‡ 12,87
6.	Geometry appears to be more useful than Algebra.	38,9	30,6	61,1	69,4	x 4,64
7.	I enjoy Algebra and Geometry equally.	46,8	39,1	53,2	60,9	3,78
8.	I cannot see the purpose of doing Algebra.	28,3	22,8	71,7	77,2	2,50
9.	Algebra is easier than Geometry.	39,2	52,4	60,8	47,6	‡ 11,02
10.	I usually understand the Geometry we do.	84,7	66,8	15,3	33,2	‡ 27,27
11.	I usually understand the Algebra we do.	76,8	73,3	23,2	26,7	0,99
12.	I should like to continue with mathematics after Standard 7.	80,3	71,3	19,7	28,7	⊕ 6,74

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Standard 6

Girls / Boys

‡	$p \leq 0{,}001$
⊕	$p \leq 0{,}01$
x	$p \leq 0{,}05$

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

SENTENCE	Agree % Girls	Agree % Boys	Disagree % Girls	Disagree % Boys	χ^2
1. I like mathematics.	86,0	87,2	14,0	12,8	0,19
2. I'd rather work a short easy problem than a long interesting one.	58,3	50,4	41,7	49,6	x 3,70
3. It scares me to have to take mathematics.	19,4	10,9	80,6	89,1	⊕ 8,04
4. Mathematics is very useful to everyone.	93,0	94,5	7,0	5,5	0,58
5. Sometimes I work extra mathematics problems.	46,2	44,9	53,8	55,1	0,10
6. Mathematics is easy for me.	58,0	57,7	42,0	42,3	0,01
7. It's fun to work with mathematics.	81,8	81,0	18,2	19,0	0,07
8. I would like a job that doesn't use any mathematics.	30,6	27,7	69,4	72,3	0,57
9. I usually understand what we are talking about in mathematics class.	84,7	84,7	15,3	15,3	0,00
10. It makes me nervous to even think about doing mathematics.	11,1	7,3	88,9	92,7	2,55
11. I like to solve new problems in mathematics.	74,5	79,9	25,5	20,1	2,42
12. I don't like to study Mathematics.	26,4	27,4	73,6	72,6	0,66
13. I have trouble with some of the terms and symbols used in mathematics.	56,7	64,2	43,3	35,8	3,48
14. No matter how hard I try, I cannot understand mathematics.	13,4	12,4	86,6	87,6	0,12
15. Mathematics is important in everyday life.	91,1	94,2	8,9	5,8	2,00
16. I am more interested in mathematics than in most other school subjects.	41,7	38,0	58,3	62,0	0,86

	SENTENCE	Agree		Disagree		χ^2
		Std6 Girls	Std6 Boys	Std6 Girls	Std6 Boys	
17.	I am not willing to study mathematics any more than I have to do.	28,0	29.9	72,0	70,1	0,26
18.	I feel relaxed and happy when working with numbers.	65,3	61.7	34,7	38,3	0,82
19.	There is very little need for mathematics in most jobs.	9,2	6,6	90,8	93.4	1,41
20.	My marks in mathematics have usually been lower than my marks in other school subjects.	30,6	38,3	69,4	61,7	x 3,90
21.	I think that mathematics is a very dull subject.	11,8	11,7	88,2	88,3	0,00
22.	I have always enjoyed mathematics.	71,0	67,5	29,0	32,5	0,84
23.	Mathematics is not very important for most people.	25,5	18,6	74,5	81,4	x 3,98
24.	Mathematics makes me feel worried and confused.	21,7	19,0	78,3	81,0	0,65
25.	I have a good feeling about mathematics.	74,2	73,4	25,8	26,6	0,05
26.	You need mathematics in order to get a good job.	87,3	92,3	12,7	7,7	^ 4,05
27.	I don't like mathematics very much.	27,1	24,1	72,9	75,9	0,68
28.	Mathematics is very interesting to me.	74,8	70,1	25,2	29,9	1,67
29.	I have a bad feeling about mathematics.	15,6	16,1	84,4	83,9	0,02
30.	I often think "I can't do it" when a mathematics problem seems hard.	58,9	56,2	41,1	43,8	0,44
31.	Most of what we learn in mathematics class is not useful.	16,2	17,2	83,8	82,3	0,09
32.	I feel calm and confident when doing mathematics.	66,9	63,9	33,1	36,1	0,59
33.	I have never enjoyed studying mathematics.	22,6	22,6	77,4	77,4	0,00
34.	Word problems in mathematics have always been difficult for me.	47,1	38,3	52,9	61,7	x 4,44
35.	Mathematics makes me feel nervous and uncomfortable.	18,5	19,0	81,5	81,0	0,03
36.	My mathematics marks have usually been higher than my marks in other subjects.	53,8	47,8	46,2	52,2	2,12
37.	Mathematics helps in other subjects.	77,4	81,8	22,6	18,2	1,70
38.	I am good at working mathematics.	61,5	63,5	38,5	36,5	0,26

	SENTENCE	Agree		Disagree		χ^2
		% Std 6 Girls	% Std 6 Boys	% Std 6 girls	% Std 6 Boys	
39.	To most people mathematics is less important than other subjects.	56,4	55,1	43,6	44,9	0,09
40.	I feel at ease in mathematics classes.	73,6	69.0	26,4	31,0	1,51
41.	I find mathematics very boring.	16,9	14,2	83,1	85,8	0,72
42.	I would like to belong to a maths. club.	35,4	35,8	64,6	64,2	0,01
43.	I am able to work mathematics without trying very hard.	32,2	41,2	67,8	58,8	5,21
44.	Mathematics is not very important to me.	14,6	10,9	85,4	89,1	1,78
45.	I just don't like mathematics.	18,8	12,4	81,2	87,6	4,48
46.	I am not frightened or afraid of mathematics.	78,7	84,7	21,3	15,3	3,50
47.	I feel I could do better in mathematics if I tried harder.	89.8	93,1	10,2	6,9	1,96
48.	I feel anxious when someone talks about mathematics.	30,6	24,5	69,4	75,5	2,74
49.	Mathematics is one of my favourite subjects.	59,6	56,9	40,4	43,1	0,41
50.	Mathematics is a very worthwhile and necessary subject.	90,8	93,8	9,2	6,2	1,86
51.	I remember most of the things I learn in mathematics.	78,0	76,6	22,0	23,4	0,16
52.	I feel sure of myself when working mathematics.	65,6	71,2	34,4	28,8	2,09
53.	I like school very much.	70,1	51,8	29,9	48,2	‡ 20,57
54.	I don't like to study school subjects.	34,7	39,8	65,3	60,2	1,61
55.	I have never enjoyed studying.	39.8	44,9	60,2	55,1	1,55
56.	I have always enjoyed going to school.	63,1	46,4	36,9	53,6	‡ 16,52
57.	There is very little need for going to school for most jobs.	4.5	5,5	95,5	94,5	0,32
58.	Schoolwork makes me feel worried and confused.	18,5	23,4	81,5	76,6	2,13
59.	I feel relaxed and happy when doing schoolwork.	62,4	47,1	37,6	52,9	‡ 13,93
60.	School is very interesting to me.	76,1	70,4	23,9	29,6	2,42
61.	I think that school is very dull.	13,1	18,6	86,9	81,4	3,42
62.	You need to go to school in order to get a good job.	97,8	98,2	2,2	1,8	0,12

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True % Girls	True % Boys	False % Girls	False % Boys	χ^2
1.	I like mathematics because my friends do.	0,6	0,4	99,4	99,6	0,21
2.	Most of my friends don't do very well in mathematics.	28,7	43,1	71,3	56,9	‡ 13,28
3.	My friends think mathematics is important.	78,7	77,7	21,3	22,3	0,07
4.	Mathematics is not a favourite subject of most of my friends.	59,6	66,4	40,4	33,6	2,95
5.	I do not like mathematics because my friends do not like it.	1,6	2,6	98,4	97,4	0,68
6.	We do a lot of small-group work in mathematics classes.	10,2	12,4	89,8	87,6	0,72
7.	I would like more class discussion in mathematics than we have now.	61,8	72,8	38,2	27,7	⊕ 7,23
8.	I think we have too much homework in mathematics.	21,0	39,4	79,0	60,6	* 23,77
9.	The homework we have is usually interesting.	73,2	65,3	26,8	34,7	× 4,33
10.	I like to use objects and other real materials when studying mathematics.	64,3	65,0	35,7	35,0	0,03
11.	We use many materials other than the textbook in our mathematics class.	33,4	31,8	66,6	68,2	0,19
12.	I don't like the textbook we use in mathematics.	32,2	21,2	67,8	78,8	⊕ 8,97
13.	I think our mathematics books are too difficult.	18,2	17,5	81,8	82,5	0,04
14.	I think our mathematics books are too easy.	14,6	12,8	85,4	87,2	0,43
15.	My father likes mathematics.	77,7	73,7	22,3	26,3	1,27
16.	My mother likes mathematics.	54,5	55,5	45,5	44,5	0,06
17.	My mother expects me to pass in mathematics.	94,3	96,7	5,7	3,3	2,00
18.	My father expects me to pass in mathematics.	95,2	96,7	4,8	3,3	0,83
19.	My mother expects me to do well in mathematics.	87,6	92,0	12,4	8,0	3,03
20.	My father expects me to do well in mathematics.	90,1	90,9	9,9	9,1	0,10
21.	My mother helps me with my mathematics homework.	21,0	18,2	79,0	81,8	0,71
22.	My father helps me with my mathematics homework.	36,0	31,0	64,0	69,0	1,62

GEM INSTANT PRINT

VII

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

SENTENCE	True		False		χ^2
	% Girls	% Boys	% Girls	% Boys	
1. I prefer Algebra to Geometry.	40,8	29,2	59,2	70,8	⊕ 8,56
2. Geometry is more interesting than Algebra.	56,4	67,5	43,6	32,5	⊕ 7,69
3. Geometry makes me feel nervous and unsure of myself.	15,6	15,0	84,4	85,0	0,05
4. I score higher marks in Algebra than in Geometry.	51,0	37,2	49,0	62,8	* 11,16
5. I enjoy doing Geometry.	76,1	78,5	23,9	21,5	0,46
6. Geometry appears to be more useful than Algebra.	38,9	54,4	61,1	45,6	* 14,20
7. I enjoy Algebra and Geometry equally.	46,8	36,1	53,2	63,9	⊕ 6,86
8. I cannot see the purpose of doing Algebra.	28,3	31,4	71,7	68,6	0,65
9. Algebra is easier than Geometry.	39,2	31,4	60,8	68,6	x 3,87
10. I usually understand the Geometry we do.	84,7	88,0	15,3	12,0	1,30
11. I usually understand the Algebra we do.	76,8	69,0	23,2	31,0	x 4,50
12. I should like to continue with mathematics after Standard 7.	80,3	86,9	19,7	13,1	4,60

GEM INSTANT PRINT

INVENTORY OF ATTITUDES TOWARDS MATHEMATICS.

Sex:	Boy	Girl
Date of test:	1983	
Age:		years
School Standard:	6	7

Standard 7

Boys / girls

‡	p ≤ 0,001
⊕	p ≤ 0,01
x	p ≤ 0,05

PART A

Below are some sentences that describe how people might feel about mathematics.

Place a tick (✓) in the column which best describes how you feel about each sentence.

	SENTENCE	Agree		Disagree		χ^2
		% Girls	% Boys	% Girls	% Boys	
1.	I like mathematics.	73,9	88,1	26,1	11,9	‡ 17,21
2.	I'd rather work a short easy problem than a long interesting one.	66,1	48,0	33,9	52,0	‡ 18,44
3.	It scares me to have to take mathematics.	30,3	11,9	69,7	88,1	‡ 26,7
4.	Mathematics is very useful to everyone.	84,7	91,4	15,3	8,6	x 5,6
5.	Sometimes I work extra mathematics problems.	39,7	36,9	60,3	63,1	0,47
6.	Mathematics is easy for me.	48,9	55,3	51,1	44,7	2,28
7.	It's fun to work with mathematics.	68,4	81,6	31,6	18,4	‡ 12,29
8.	I would like a job that doesn't use any mathematics.	42,3	20,5	57,7	79,5	‡ 29,52
9.	I usually understand what we are talking about in mathematics class.	77,2	88,5	22,8	11,5	‡ 11,43
10.	It makes me nervous to even think about doing mathematics.	21,2	11,1	78,8	88,9	⊕ 9,98
11.	I like to solve new problems in mathematics.	62,2	80,7	37,8	19,3	‡ 22,34
12.	I don't like to study Mathematics.	34,2	27,9	65,8	72,1	2,53
13.	I have trouble with some of the terms and symbols used in mathematics.	69,1	68,4	30,9	31,6	0,02
14.	No matter how hard I try, I cannot understand mathematics.	24,1	10,7	75,9	89,3	‡ 16,55
15.	Mathematics is important in everyday life.	85,7	91,8	14,3	8,2	x 4,99
16.	I am more interested in mathematics than in most other school subjects.	36,5	41,8	63,5	58,2	1,62

	SENTENCE	Agree		Disagree		χ^2
		% Girls	% Boys	% Girls	% Boys	
17.	I am not willing to study mathematics any more than I have to do.	43,0	31,1	57,0	68,9	⊕ 8,12
18.	I feel relaxed and happy when working with numbers.	59,0	69,7	41,0	30,3	⊕ 6,75
19.	There is very little need for mathematics in most jobs.	12,4	9,4	87,6	90,6	1,20
20.	My marks in mathematics have usually been lower than my marks in other school subjects.	41,7	36,9	58,3	63,1	1,31
21.	I think that mathematics is a very dull subject.	21,8	12,3	78,2	87,7	⊕ 8,51
22.	I have always enjoyed mathematics.	58,0	66,4	42,0	33,6	x 4,07
23.	Mathematics is not very important for most people.	39,1	25,0	60,9	75,0	ǂ 12,23
24.	Mathematics makes me feel worried and confused.	32,6	18,9	67.4	81,1	ǂ 13,14
25.	I have a good feeling about mathematics.	59,3	74,2	40,7	25,8	ǂ 13,42
26.	You need mathematics in order to get a good job.	74,9	87,7	25,1	12,3	ǂ 14,20
27.	I don't like mathematics very much.	37.5	24,2	62,5	75,8	ǂ 11,09
28.	Mathematics is very interesting to me.	59,0	73,4	41,0	26,6	ǂ 12,45
29.	I have a bad feeling about mathematics.	26,7	16,0	73,3	84,0	⊕ 9,13
30.	I often think "I can't do it" when a mathematics problem seems hard.	64,2	55,7	35,8	44,3	x 4,04
31.	Most of what we learn in mathematics class is not useful.	24,4	21,3	75,6	78,7	0,75
32.	I feel calm and confident when doing mathematics.	50,8	64,3	49.2	35,7	⊕ 10,14
33.	I have never enjoyed studying mathematics.	31,3	23,0	68,7	77,0	x 4,71
34.	Word problems in mathematics have always been difficult for me.	55,7	44,7	44,3	55,3	x 6,62
35.	Mathematics makes me feel nervous and uncomfortable.	25,4	18,0	74,6	82,0	x 4,29
36.	My mathematics marks have usually been higher than my marks in other subjects.	42,0	53,7	58,0	46,3	⊕ 7,43
37.	Mathematics helps in other subjects.	69,7	85,7	30,3	14,3	ǂ 19,34
38.	I am good at working mathematics.	46,3	59,8	53,7	40,2	⊕ 10,05

SENTENCE	Agree		Disagree		χ^2
	% Girls	% Boys	% Girls	% Boys	
39. To most people mathematics is less important than other subjects.	62,2	49,6	37,8	50,4	⊕ 8,82
40. I feel at ease in mathematics classes.	60,6	77,5	39,4	22,5	‡ 17,80
41. I find mathematics very boring.	23,8	14,3	76,2	85,7	⊕ 7,68
42. I would like to belong to a maths. club.	33,6	34,0	66,4	66,0	0,01
43. I am able to work mathematics without trying very hard.	30,3	43,0	69,7	57,0	⊕ 9,58
44. Mathematics is not very important to me.	29,6	16,8	70,4	83,2	‡ 12,30
45. I just don't like mathematics.	29,3	16,0	70,7	84,0	‡ 13,48
46. I am not frightened or afraid of mathematics.	73,3	81,6	26,7	18,4	x 5,24
47. I feel I could do better in mathematics if I tried harder.	90,2	92,2	9,8	7,8	0,66
48. I feel anxious when someone talks about mathematics.	29,3	24,2	70,7	75,8	1,82
49. Mathematics is one of my favourite subjects.	53,7	63,1	46,3	36,9	x 4,90
50. Mathematics is a very worthwhile and necessary subject.	85,7	91,8	14,3	8,2	x 4,79
51. I remember most of the things I learn in mathematics.	63,5	77,5	36,5	22,5	‡ 12,51
52. I feel sure of myself when working mathematics.	48,5	59,8	51,5	40,2	⊕ 6,48
53. I like school very much.	64,5	56,1	35,5	43,9	x 3,97
54. I don't like to study school subjects.	36,2	40,6	63,8	59,4	1,12
55. I have never enjoyed studying.	35,5	46,3	64,5	53,7	x 6,60
56. I have always enjoyed going to school.	56,4	50,4	43,6	49,6	1,93
57. There is very little need for going to school for most jobs.	2,9	2,9	97,1	97,1	0,19
58. Schoolwork makes me feel worried and confused.	21,8	17,2	78,2	82,8	1,89
59. I feel relaxed and happy when doing schoolwork.	59,3	54,9	40,7	45,1	1,06
60. School is very interesting to me.	74,6	73,4	25,4	26,6	0,11
61. I think that school is very dull.	19,2	22,1	80,8	77,9	0,71
62. You need to go to school in order to get a good job.	98,7	97,5	1,3	2,5	1,02

PART B

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		% Girls	% Boys	% Girls	% Boys	
1.	I like mathematics because my friends do.	0,0	1,2	100,0	98,8	3,80
2.	Most of my friends don't do very well in mathematics.	42,7	38,5	57,3	61,5	0,97
3.	My friends think mathematics is important.	70,7	84,4	29,3	15,6	‡ 14,40
4.	Mathematics is not a favourite subject of most of my friends.	65,1	64,8	34,9	35,2	0,92
5.	I do not like mathematics because my friends do not like it.	0,6	2,0	99,4	98,0	2,12
6.	We do a lot of small-group work in mathematics classes.	16,0	11,1	84,0	88,9	2,74
7.	I would like more class discussion in mathematics than we have now.	64,2	73,0	35,8	27,0	x 4,82
8.	I think we have too much homework in mathematics.	24,1	34,8	75,9	65,2	⊕ 7,63
9.	The homework we have is usually interesting.	59,9	61,9	40,1	38,1	0,22
10.	I like to use objects and other real materials when studying mathematics.	51,8	59,0	48,2	41,0	2,87
11.	We use many materials other than the textbook in our mathematics class.	13,7	15,6	86,3	84,4	0,39
12.	I don't like the textbook we use in mathematics.	22,8	23,4	77,2	76,6	0,02
13.	I think our mathematics books are too difficult.	26,4	18,9	73,6	81,1	x 4,35
14.	I think our mathematics books are too easy.	9,4	13,5	90,6	86,5	2,26
15.	My father likes mathematics.	69,4	73,0	30,6	27,0	0,84
16.	My mother likes mathematics.	46,6	52,0	53,4	48,0	1,63
17.	My mother expects me to pass in mathematics.	88,6	94,3	11,4	5,7	x 5,38
18.	My father expects me to pass in mathematics.	90,2	96,3	9,8	3,7	⊕ 7,65
19.	My mother expects me to do well in mathematics.	75,2	87,7	24,8	12,3	‡ 13,59
20.	My father expects me to do well in mathematics.	76,2	88,9	23,8	11,1	‡ 14,79
21.	My mother helps me with my mathematics homework.	13,7	12,7	86,3	87,3	0,11
22.	My father helps me with my mathematics homework.	30,3	26,2	69,7	73,8	1,10

PART C.

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

	SENTENCE	True		False		χ^2
		% Girls	% Boys	% Girls	% Boys	
1.	I prefer Algebra to Geometry.	57,7	46,3	42,3	53,7	⊕ 7,02
2.	Geometry is more interesting than Algebra.	43,0	56,1	57,0	43,9	⊕ 9,41
3.	Geometry makes me feel nervous and unsure of myself.	29,3	18,4	70,7	81,6	2,69
4.	I score higher marks in Algebra than in Geometry.	60,3	53,7	39,7	46,3	2,40
5.	I enjoy doing Geometry.	62,9	73,4	37,1	26,6	⊕ 6,23
6.	Geometry appears to be more useful than Algebra.	30,6	39,8	69,4	60,2	× 5,01
7.	I enjoy Algebra and Geometry equally.	39,1	42,7	60,9	57,4	0,70
8.	I cannot see the purpose of doing Algebra.	22,8	25,4	77,2	74,6	0,51
9.	Algebra is easier than Geometry.	52,4	44,3	47,6	55,7	3,64
10.	I usually understand the Geometry we do.	66,8	78,7	33,2	21,3	⊕ 9,58
11.	I usually understand the Algebra we do.	73,3	76,2	26,7	23,8	0,62
12.	I should like to continue with mathematics after Standard 7.	71,3	93,0	28,7	7,0	* 41,49