

AN INVESTIGATION INTO GENDER DIFFERENCES IN ATTITUDES TO SCIENCES AND HOW THEY AFFECT SCIENCE ACHIEVEMENT LEVELS AMONG PUPILS IN SELECTED SECONDARY SCHOOLS IN THE COPPERBELT PROVINCE.

THESIS
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1993

BY

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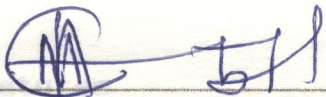
A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION OF THE UNIVERSITY.

THE UNIVERSITY OF ZAMBIA
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1993

DECLARATION

I Annette Chomba Mbulwe do hereby declare that
252554
this dissertation represents my own work and that it
has not previously been submitted for a degree at
the University of Zambia or any other University.

Signature  _____

Date 23rd March 1993 1994, 7th June

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ABSTRACT III

APPROVAL

Science and Technology have been identified as being critically important for national and personal development and advancement in the modern world. Therefore it is important

This dissertation of Annette Chomba Mbulwe has been approved as meeting the requirements for the award of the Master of Education by the University of Zambia.

However there are remarkable disparities in both participation and achievement in science between males and females with males over-represented and females under-represented. These disparities have been attested in Zambia as well as in other countries.

Examiners' Signatures

1. *M. Kelly* 1994, 7th June

To examine certain aspects of this problem investigations of females' poor participation and achievement in science were conducted. The present study looked at attitudes as one of the

prime factors related to academic achievement which lead to differential participation of males and females in science. It

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a) the relationship between gender of Grade Twelve pupils and their attitudes towards the study of science.

b) the relationship between career preference, parents', peers' and teachers' attitudes and attitudes of Grade Twelve boys and girls towards the study of science.

c) the relationship between Grade Twelve boys' and girls' attitudes and their level of achievement in science examinations.

ABSTRACT

Science and Technology have been identified as being critically important for national and personal development and advancement in the modern world. Therefore it is important that human resource development involves both males and females. However there are remarkable disparities in both participation and achievement in science between males and females with males over-represented and females under-represented. These disparities have been attested in Zambia as well as in other countries.

To examine certain aspects of this problem investigations of females' poor participation and achievement in science were conducted. The present study looked at attitudes as one of the prime factors related to academic achievement which lead to differential participation of males and females in science. It sought to investigate:

- a) the relationship between gender of Grade Twelve pupils and their attitudes towards the study of science.
- b) the relationship between career preference, parents', peers' and teachers' attitudes and attitudes of Grade Twelve boys and girls towards the study of science.
- c) the relationship between Grade Twelve boys' and girls' attitudes and their level of achievement in science examinations.

The findings were that boys have significantly more favourable attitudes to the study of science than girls. The results also showed that parents, teachers and peers all have significantly more favourable attitudes to the study of science by boys than to its study by girls. This implies that parents, teachers and peers as agents of socialisation would rather see more males than females in science and technological fields. Such negative attitudes to the study of science by girls contribute to the less favourable attitudes girls themselves have towards the study of science.

It is a pleasure to acknowledge and to appreciate for assistance rendered to me by a number of sources. Without their generous help it could have been difficult for this thesis to come into being. My debt also extends very particularly to Moelembwe Secondary Schools. Firstly, I owe a very special and sincere debt of gratitude to Professor M.J. Kelly of the University of Zambia for supervising my study despite his already heavy work-load. He was always keen to give me guidance and helpful comments throughout. I really thank him for suggesting and providing me with a lot of materials that made me gain a very wide knowledge on the study. He was also very understanding and gave me advice on social problems I encountered during my study. My sponsorship possible. I also thank Zambia Consolidated Copper Mines (ZCCM) for transferring my husband from Ixpress very sincere thanks to lecturers of the University of Zambia such as Dr. Kasanda, Dr. Lungwangwa, Dr. Kabwe, Dr. Chakulimba, Mrs. Kasonde Ng'andu, and Professor Tembo for having cooperated in the production of the thesis. I am also very grateful to my friend Margaret M. Machila for her bright ideas and guidance as one who is well acquainted with gender issues. I also thank Mrs. Varghese for sharing with me some of her work on gender issues.

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CHAPTER ONE

INTRODUCTION

BACKGROUND

When Zambia became independent in 1964 it inherited a very small labour force which had a low level of education. As in most colonies, education of the indigenous people had been neglected to a large extent. Consequently, at the time of independence only 1,000 Zambian nationals had secondary school certificates and only 108 were degree holders (ZARD, 1985). It was against this poor educational background and lack of skilled manpower that the government of Zambia after independence adopted a policy of rapidly expanding the educational system.

It has been argued that "the involvement of a people in science and science-related fields is often employed as an index of the particular country's level of progress" (Hamilton, 1982). Therefore, recognising this importance of science, one of the most stressed objectives of Zambian secondary education is to strengthen the teaching and learning of science in secondary schools. This is fundamental to the training of personnel required for technological development and advancement.

However, we cannot deny the fact that this objective has not yet been achieved. Zambia still depends heavily on expatriate skilled manpower in the areas of science and technology. Kelly *et. al.* (1986) attribute the gloomy state of science learning to lack of science teachers and limited

teaching resources. This situation has been worsened by the mass exodus of indigenous science teachers to other countries. Consequently, as Munachonga (1988) notes, there is a bias in favour of arts with fewer students passing and entering science and technological related areas at college and university levels.

One well documented aspect of the unsatisfactory performance in science is the great disparities in participation between men and women in science. Bardouille (1982), Achola (1983), Tembo (1983), and Munachonga (1988) have explicitly dealt with these differences which table 1 also illustrates.

Table 1: STUDENT ENROLMENT BY SCHOOL AT THE UNIVERSITY OF ZAMBIA: UNDERGRADUATE 1990/91 ACADEMIC YEAR.

School	Male	Female
Agricultural Sciences	198	18
Engineering	367	3
Education	611	238
Humanities and Social Sciences	649	329
Law	95	31
Medicine	172	91
Mines	123	0
Natural Sciences	688	110
Veterinary Sciences	80	11

Source: University of Zambia Computer Centre, 1991

Another more serious situation compounded with the above bias is the well attested observation that the academic achievement of female pupils in science is generally lower than that of the males (Shifferraw 1982). Kelly (1991) deals quite extensively with differential performance by gender in the Grades Seven, Ten and Twelve examinations and shows that in all Grade Seven and in most Grade Twelve subjects, especially in science, girls perform more poorly than boys. Other studies, including those by Harvey and Edwards (1980) and Hamilton (1982), concluded that women seem to have more positive attitudes and perform better in biological sciences than in physical sciences. Similarly, Kaminski (1985) noted that there are many women scientists especially medical doctors in Eastern European countries, but relatively few in the physical sciences. Bardouille (1982) in her study of the 1976 University of Zambia graduates also showed that there were more females in the biological and medical fields than in physical sciences. The same idea is clearly brought out for almost all countries by the World Education Report (UNESCO,1991). Table 2 gives a few examples from the report for the year 1988.

process through which the culture of a society and the expected patterns of behaviour are transmitted to its new members (Datta, 1979). In this process children build their

Country Percentage of Females in a field of study

Country	Natural Sciences	Medical Engineering and Agriculture Sciences
Zambia	5	35
Kenya	14	45
Mozambique	17	55
Ghana	9	24

behaviour and personalities by internalising attitudes, values, beliefs, feelings and ways of behaving from the people around them. Important influences in this respect come from the family, age-mates, school colleagues and teachers. It is through this process of socialisation that boys and girls learn different gender roles and expectations according to gender stereotypes.

According to Dannigan (quoted in Michel 1986, p.15) a

STATEMENT OF THE PROBLEM

stereotype is a "rigid impersonal model on the basis of which images or behaviour are automatically reproduced." These

The question one asks is why there are such disparities in participation and achievement between males and females. that men are credited with having certain positive qualities (courage, intelligence, self confidence, professional competence, a taste for risk and adventure, the spirit of initiative, efficiency), while women are seen as lacking these gender inequalities (which simply means unequal treatment of males and females) which in turn form part of social inequalities. Most studies, such as those discussed in Chapter II below argue that females are generally more at a disadvantage than males in areas of school enrolment, school subject differentiation, training, employment and the like. and discrediting women. is found in virtually all societies of the world today. According to Kaninski (1985) the socialisation and child-rearing practices girls go through do which lead to differential participation of males and females not encourage independence, curiosity, active experiments and manipulation of the physical and abstract world. Commonly

These gender inequalities could well be explained and understood in terms of theories of socialisation. According to these theories, every child undergoes socialisation or a

process through which the culture of a society and the significant others like the parents, siblings, relatives, expected patterns of behaviour are transmitted to its new members (Datta, 1979). In this process children build their behaviour and personalities by internalising attitudes. Therefore they develop certain attitudes towards the study of values, beliefs, feelings and ways of behaving from the people around them. Important influences in this respect come from the family, age-mates, school colleagues and teachers. It is through this process of socialisation that boys and girls learn different gender roles and expectations according to gender stereotypes.

According to Dannigan (quoted in Michel 1986, p.15) a stereotype is a "rigid impersonal model on the basis of which images or behaviour are automatically reproduced." These gender stereotypes assigned to men and women are biased in that men are credited with having certain positive qualities (courage, intelligence, self confidence, professional competence, a taste for risk and adventure, the spirit of initiative, efficiency), while women are seen as lacking these "manly" qualities, while possessing their own "feminine" virtues. Therefore there were three major aspects of the problem that which men supposedly lack (Michel 1986). The gender stereotyping of the behaviour of men and women, favouring men and discrediting women, is found in virtually all societies of the world today. According to Kaminski (1985) the socialisation and child-rearing practices girls go through do not encourage independence, curiosity, active experiments and manipulation of the physical and abstract world. Commonly held gender stereotypes about women are that they are weak in abstract subjects. These gender stereotypes, held by

OBJECTIVES OF THE STUDY

significant others like the parents, siblings, relatives, peers and teachers, are internalised by girls who accept that they cannot compete with boys in areas such as science. Therefore they develop certain attitudes towards the study of science that tend to influence their levels of achievement.

An analysis of school examination results especially in science reveals marked differences in achievement between boys and girls which lead to over-representation of boys and under-representation of girls in both the study of science and employment that involves or requires knowledge of science.

Whilst there are a number of factors related to academic achievement in schools, attitudes are of prime importance.

HYPOTHESES

They determine for each individual "what he will see and hear, what he will think and what he will do" (Jahoda and Warren, 1966, p.32). The questions that arise are whether boys and girls have different attitudes to science, where the attitudes originate and how such attitudes relate to achievement levels.

As a guide to the research, the study set up the following three null hypotheses to be tested at .001, .01 and .05 levels of significance:

(i) There is no relationship between gender and the attitudes that Grade Twelve boys and girls have towards the study of science.

- (ii) There is no relationship between selected variables
 - (a) possible differential attitudes to sciences;
 - (b) the origins or genesis of such attitudes;
 - (c) the relationship of such attitudes to achievement.

(iii) There is no relationship between gender attitudes and Grade Twelve pupils' levels of achievement in science examinations.

OBJECTIVES OF THE STUDY

SIGNIFICANCE OF THE STUDY

In the light of these issues, this study set out to examine and establish the attitudes that Grade Twelve boys and girls hold towards the study of science. Secondly, the study investigated the extent to which career preference and parents', peers' and teachers' attitude influence attitudes that Grade Twelve boys and girls hold towards the study of science. Lastly, the study examined the extent to which differential attitudes of boys and girls affect levels of achievement in a science examination.

education reforms and in government policy statements (Kelly et al 1986).

HYPOTHESES

As a guide to the research, the study set up the following three null hypotheses, to be tested at .001, .01 and .05 levels of significance:

- (i) There is no relationship between gender and the attitudes that Grade Twelve boys and girls have towards the study of science.
- (ii) There is no relationship between selected variables (career preference; parents', peers' and teachers' attitudes) and gender attitudes of Grade Twelve boys and girls towards the study of science.
- (iii) There is no relationship between gender attitudes and Grade Twelve pupils' levels of achievement in science examinations.

SIGNIFICANCE OF THE STUDY

The development of properly qualified human resources in science and technology as a vital ingredient of successful national development cannot be disputed. Recognising this fact, Zambia has attached great importance to the teaching and learning of science in secondary schools so that the development of adequate and appropriate science and technology could materialise. This has frequently been reflected and emphasised in the four national development plans, in the education reforms and in government policy statements (Kelly et al 1986).

An important question to which we should address ourselves is: does national development which science and technology bring mean opportunity primarily for males? This is somehow implied in the Employment of Women, Young Persons and Children Act, Cap. 505 of the Laws of Zambia. According to this Act women are forbidden to be employed in mines, quarries and other works for extraction of minerals

LIMITATIONS OF THE STUDY

It was not possible to investigate all the potential factors that might influence the pupils' attitudes to the study of science, such as the media or religious views. This is clearly a limitation. The study also restricted itself to establishing the extent to which academic achievement is determined by attitudes and not any other factors. Thirdly,

pose a problem. If there is to be balanced and authentic national development then that development must encompass both males and females.

DEFINITION OF TERMS

But in fact, there is little participation of women in science which, according to the hypothesis of this study, is due in part to negative attitudes to science. Further, if national policies of developing highly qualified manpower in science and technology and of the integration of women in all areas are to be achieved, then it is imperative that investigations be conducted on attitudes and how they affect females' levels of achievement which in turn condition their participation in science. In this way, the present study would contribute to a better understanding of the factors that obstruct the development of science and technology in Zambia as a nation and among women in particular. A study of this nature is also called for because, unlike in developed countries, gender attitudes and achievements have not been extensively studied in Zambia or in Africa.

called "science".

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because the study only covered some schools in the Copperbelt Province and not the whole country, the findings may not be generalised to all Zambian pupils.

DEFINITION OF TERMS

The terms used in the study have the following meanings:

1. Sex: biological differences between males and females that are physical, universal and unchanging.
2. Gender: the social differentiation between women and men, reflecting the different social, cultural and economic roles they are required to play. These roles vary between different societies and cultures and at different periods of history.
3. Co-educational school - A school with both male and female pupils;
4. Single-sex school - A school with only female or male pupils;
5. Academic achievement - In this study it refers to the academic performance of a pupil in a purpose - designed Grade Twelve test in a science subject called "science".
6. Gender stereotyping - A way of looking at reality so that images or behaviour favourable to men and unfavourable to women are produced automatically (based on Michel's 1986, description of sex stereotyping").
7. Attitude - The degree of positive or negative affect associated with some psychological object (Edwards, 1957)

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Internationally there has been a great deal of research on the attitudes school boys and girls have towards science. A study by Butcher and Pont (1968) confirmed that boys have greater interests in science than girls and that girls' attitudes seem to be strongly negative. In support of this view, Harvey and Edwards (1980) also found that for primary school children, interest in science appears to be fixed by the age of seven. In addition, they also commented that boys are far more interested in physical science than girls, whereas for biological science the interests of both boys and girls were the same. Another study by Harvey (1985) confirmed that in addition to boys having more positive attitudes to science in general, the boys in mixed-sex groups have slightly more positive attitudes to practical science than those in single-sex groups. The same was true with girls.

Some studies have also argued that teachers who direct learning activities towards the attainment of educational objectives instil certain attitudes in their pupils. Dale (1974) and Johnstone (1974) indicate that girls are more influenced by their science teachers than boys and that an enthusiastic teacher seems to produce more girl scientists.

exam Apart from studies on attitudes to science, other studies have also indicated gender differences in a variety of intellectual tasks especially in science-related subjects, with boys performing better than girls. Yet another set of studies has dealt with the relationship between attitude and achievement. It is asserted that there is an important interrelationship between attitude and achievement, be it in science or other areas. Meyer and Denford (1961) in their study strongly suggested that there is evidence that good attainment in science follows an interest in it. Furthermore, Cronbach (1977) points out that interest patterns have as much to do with persistence and success in a line of studies as do abilities. The question of attitude and achievement was further investigated by Warburton and Jenkins (1983). They found that pupils who transferred from primary to secondary school at the age of thirteen in England scored higher in both achievement and attitude tests than those who transferred at eleven and twelve. They attributed this positive and high achievement to the "process approach to science." This study did not calculate the correlations between positive attitude and high achievement. However, although not so much concerned with gender differences, the study further confirmed that on average, boys had a more favourable attitude to science than girls. relates to levels of achievements of both boys and girls. As the literature points out, an individual is not born. A study which is expressly gender-oriented in relating her attitude to achievement in science and therefore in line with the present study was undertaken by Hamilton (1982). He

examined Form Five and Six students' attitudes to science and their relationship to achievement. The science attitude inventory developed by Sutman and Moore (1970) was used to determine students' attitudes, while General Certificate of Education Ordinary and Advanced Level Science Examinations were used as indices of science achievement. Hamilton found that at Form Five level, there was a relationship between achievement and attitude and that girls entered for and passed significantly fewer science subjects than boys. However, for Form Five high achievers there was no significant difference between genders, neither on attitudes nor on achievement. In addition, attitudes and achievement correlated significantly for high achieving girls, but not for boys. In Sixth Form, the girls' performance was better in the biological sciences than in the physical sciences. This study confirms that gender differences in attitudes are closely associated with performance in science, as presented at a workshop held in 1987 in Accra, Ghana. It reported that although science and maths. It seems that the western studies reviewed above have dealt extensively with "pupils' attitudes to science" and "attitudes to science and achievement." However, one aspect which so far has only been marginally explored is the effect of the gender factor in forming the attitude to science and how it relates to levels of achievements of both boys and girls. As the literature points out, an individual is not born with attitudes towards science or indeed any other subject, including arts subjects and boys taking sciences. This

In the African context, many organisations which have sprung up to deal with gender issues have conducted a variety of studies on participation of women in the economy, politics, top administrative and managerial posts, science and technology and theories. A few have looked at the attitudes of girls and others have dealt with the under-representation of women in science and technology and so on. Kamara (1978), in a paper presented at a workshop on gender-stereotyping held in 1978 in Sierra Leone, points to the glaring gender imbalances in the participation of men and women in a Science Educators Training Course, with men outnumbering women by more than five to one. This course was established in 1975 in Sierra Leone for Eastern, Southern, Central and Western countries of Africa. According to Kamara, from 1975-1978 out of a total of 114 participants only 20 were females. Another paper on Gender Stereotyping in Science Technology and Mathematics Education was presented at a workshop held in 1987 in Accra, Ghana. It reported that although science and mathematics are compulsory in Malawian schools, many girls are usually passive and lack interest in them (Malawi). science-oriented ones like engineering. Thus, Shifferraw's study high A similar picture is depicted for Botswana by Clegy and Duncan (1985) and for Swaziland by Wheldon and Smith (1987). Wheldon and Smith analysed the 1985 O-Level results of 1027 girls and 1231 boys on a gender basis. They found that there was a pronounced gender bias in subject selection with more girls taking arts subjects and boys taking sciences. This ver, although his study is quite relevant to the present

gender bias was even higher for single sex schools than co-education schools. On performance, the study found that there was little difference in the pass rate between girls and boys but at credit level and above, girls performed better in languages and boys in science. Among other things that girls' enrolment lags behind boys. He concluded this was due to socialisation.

In Zambia, studies that have been conducted by Shifferraw (1982), Martin (1983), Khabele (1983), Achola (1983), Munachonga (1985), Varghese (1987), Serpell (1987) and Kelly (1991) are relevant and of special interest to the present research problem. In her study of the socialisation of girls in Zambian secondary schools, Shifferraw analysed among other things the attitudes of both girls and teachers as manifested in their cultural bias towards women's education. Girls thought the subject of homecraft was more useful to them and science to boys. On the other hand, teachers' attitudes emphasised the weakness of girls in science and mathematics. She also found that the prevailing gender-biased subject specialisation limits women's employment to careers like nursing, teaching and secretarial work and not science-oriented ones like engineering. Thus, Shifferraw's study highlights some of the issues in the present study. They feel they cannot venture into the male-dominated fields of science and technology.

Khabele (1983) also looked at attitudes and opinions of Zambian secondary school pupils towards biology. Like some studies in the west, Khabele found that regardless of gender, all pupils had positive attitudes towards Biology. However, although his study is quite relevant to the present

investigation, Khabele does not deal with the gender factor in detail. Unlike Shifferraw, he does not include variables that may have explained the difference between the sexes. Martin (1983) dealt with gender differentiation in secondary education and concluded among other things that girls' enrolment lags behind boys. He concluded this was due to social organisation, curriculum and attitudes of students and teachers which revolve around specific gender roles and reinforce the belief that women are not only different but inferior to men.

(b) Many parents are not willing to spend money on

In his analysis of text books used in primary and junior secondary schools, Tembo (1983) similarly found that through teaching materials men are depicted to be superior to women in intelligence, creativity, invention, adventure and curiosity. Hence he concluded that the school system, like the family and mass media clearly reinforces and perpetuates gender stereotyping. Furthermore, Achola (1983) and Munachonga (1985) show great disparities between males and females in educational, training and employment opportunities. They have also shown that females are under-represented in science-related fields because society and they themselves feel they cannot venture into the male-dominated fields of science and technology.

Varghese (1987) in her study which had a sample of 900 girls, 200 teachers, 200 parents and 220 young men looked at "views on 'STM' (Science Technology and Mathematics) among girls in Zambia." She concluded among other things that despite girls realising the importance of science, technology and mathematics, they are not keen to take up the STM professions due to several factors:

(a) The traditional society does not encourage girls to take up such courses;

(b) Many parents are not willing to spend money on having girls taught in STM studies;

(c) Teachers give more attention to boys as they feel that boys are more resourceful than girls;

(d) Girls themselves are not highly motivated.

The other recent studies by Serpell (1987) and Kelly (1991) lend further support to these views. Serpell in his study of teachers, pupils and parents in the Eastern Province concluded among other things that teachers appear to define the goals of education differently for boys and girls. The emphasis on literacy and on skills for the local economy was greater for boys than for girls while the emphasis on domestic much attention has specifically been given to the way gender differences in attitudes relate to levels of achievement in

skills and knowledge was greater for girls than for boys. According to Serpell these differences in the defining of educational goals could only be understood as deriving from assumptions about the gender roles of men and women in adulthood. Similarly, Kelly's detailed study indicates substantial differences in performance between boys and girls in almost all the subjects in Grade Seven and senior secondary school examinations. He found that the differences were particularly pronounced in science subjects. The percentage of boys passing examinations is consistently higher than that of girls. As with the foregoing studies, Kelly attributes these differences to the expectations that girls cannot perform as well as boys and these expectations are harmful to the self-image entertained by girls.

From the foregoing review, it is clear that pupils' attitudes, attitudes to science, and achievement in science subjects have been extensively dealt with. It is also found that boys have more favourable attitudes and perform better than girls especially in physical sciences. It is also asserted that girls like boys have favourable attitudes to biological sciences and perform as well as boys. However, not much attention has specifically been given to the way gender differences in attitudes relate to levels of achievement in

science especially in Zambia. There has also been no research expressly concerned with the genesis of these attitudes. In the light of this gap in the literature and the importance of the full integration of women in science and technology an investigation into their gender attitudes and how they affect levels of achievement in science is timely. If genesis of attitudes is known, the possibility of doing something about them can be examined.

POPULATION

The population for the study comprised all Grade Twelve pupils in secondary schools in the Copperbelt Province in 1991. It also included the parents, peers and teachers of the same pupils. Grade Twelve pupils were selected for the study because their performance in science examinations usually determines whether or not they would enter science and technological fields in colleges and universities. Grade Twelve pupils are also in a better position than any other pupils to know the usefulness of subjects for their later lives. In addition, at their age, Grade Twelve pupils have already to a large extent formed their attitudes towards the study of science. The parents, peers and teachers formed part of the population as the possible origins of the pupils' attitudes because they are closest to and are the most important agents of socialisation of the involved pupils.

PROCEDURE AND METHODOLOGY

The various aspects of procedure and methodology are summarised below in accordance with the problem, purpose and hypotheses.

POPULATION

The population for the study comprised all Grade Twelve pupils in secondary schools in the Copperbelt Province in 1991. It also included the parents, peers and teachers of the same pupils. Grade Twelve pupils were selected for the study because their performance in science examinations usually determines whether or not they would enter science and technological fields in colleges and universities. Grade Twelve pupils are also in a better position than any other pupils to know the usefulness of subjects for their later lives. In addition, at their age, Grade Twelve pupils have already to a large extent formed their attitudes towards the study of science. The parents, peers and teachers formed part of the population as the possible origins of the pupils' attitudes because they are closest to and are the most important agents of socialisation of the involved pupils.

1. Mukuba Sec School	Boys' School	50	50
2. Luanshya Sec School	Girls' School	50	50
3. Chingola Sec School	Co-educational Sch.	25	25
4. Mufulira Sec School	Co-Educational Sch.	25	25
Totals - 4 Schools		100	100

SAMPLE AND SAMPLING PROCEDURES

The total of 24 senior secondary schools in the Copperbelt Province consists of 15 co-educational schools, 4 boys' schools and 5 girls' schools. Random sampling using random numbers was used to select two co-educational schools, one single-sex school for boys and another single-sex school for girls. A sample of 100 girls and 100 boys was randomly selected from these schools as follows: 15 teachers, male and female were randomly selected from each of the 4 schools,

(a) 50 girls from a girls' school

(b) 50 boys from a boys' school

(c) 25 girls and 25 boys from the first co-educational school

(d) 25 girls and 25 boys from the second co-educational school.

The sampling is illustrated in Table 3. (appendices ABC).

Statements such as the following were included:

1. Science is difficult (pupils' questionnaire)

TABLE 3

SAMPLE OF SCHOOLS AND PUPILS

NAME OF SCHOOL	TYPE	SAMPLE	
		Girls	Boys
1. Mukuba Sec School	Boys' School	-	50
2. Luanshya Sec School	Girls' School	50	-
3. Chingola Sec School	Co-educational Sch.	25	25
4. Mufulira Sec School	Co-Educational Sch.	25	25
Totals - 4 Schools		100	100

Before questionnaires were constructed, the researcher had discussions with some parents, teachers, pupils, colleagues and University lecturers. The focus of the discussions was Copperbelt private schools take mostly pupils who have failed in regular schools. This systematic bias towards those who performed poorly could affect the validity of the results of the study.

Although private schools were part of the population, they were not included in the sample because many of the Copperbelt private schools take mostly pupils who have failed in regular schools. This systematic bias towards those who performed poorly could affect the validity of the results of the study. All three questionnaires used the Likert-type scale except for one question in the pupils' questionnaire which required pupils to rank occupations in terms of their liking for them. The respondents were asked to be honest and frank in ticking the answers in the boxes that best described their own feeling about each statement. The answers ranged from the most to the least favourable for the positive statements, and from the least to the most favourable for the negative statements.

CONSTRUCTION OF RESEARCH INSTRUMENTS

Attitudes and their genesis were investigated by the use of questionnaires. Three questionnaires were used, prepared separately for pupils, parents and teachers (appendices ABC). Statements such as the following were included:

1. Science is difficult for me (pupils' questionnaire)
2. Subjects such as English, History, Geography are easier for girls than science is (parents' questionnaire).
 - (a) Pupils' attitudes to science.
 - (b) Parents' attitude to the study of science by girls and by boys.
3. Boys could usually be more keen to demonstrate an experiment to a class than girls (teachers' questionnaire).
 - (c) Career preferences and
 - (d) Career ranking.

Before questionnaires were constructed, the researcher had discussions with some parents, teachers, pupils, colleagues and University lecturers. The focus of the discussions was the attitudes of pupils, teachers and parents towards science. Relevant books were also consulted in the construction of the questionnaires. All three questionnaires used the Likert-type scale except for one question in the pupils' questionnaire which required pupils to rank occupations in terms of their liking for them. The respondents were asked to be honest and frank in ticking the answers in the boxes that best described their own feeling about each statement. The answers ranged from the most to the least favourable for the positive statements, and from the least to the most favourable for the negative statements.

To disguise the purpose of the questionnaires some filler statements which had no relationship with the research were included. For the same reason the questionnaires were not divided into parts. However, after the questionnaires were answered, they were divided into different parts. The questionnaire for pupils had four parts:-

TYPE OF DATA AND SCORING PROCEDURE

- (a) Pupils' attitudes to science;
- (b) Peers' attitude to the study of science by girls and by boys;
- (c) Career preferences and
- (d) Career ranking.

The questionnaire for parents had two parts:- moderate achievers while those who scored 49 marks and below were in the low achievers.

(a) Parents' attitudes to the study of science by boys

(b) Parents' attitudes to the study of science by girls.

was used for the attitude questionnaires. A response to a

The questionnaire for teachers also had two parts:- favourable

attitude to science had the highest score and the most

unfavourable (a) Teachers' attitudes to the study of science by boys

shows. and scores were reversed for the negative statements

as shown in example 2 below:-

Example (b) Teachers' attitudes to the study of science by

girls. by other subject.

Strongly agree 5, agree 4, undecided

Another research instrument used was an examination

especially prepared for the research in the subject called

'Science', which is a combination of Physics and Chemistry

(appendix D). The paper was prepared by senior physics and

chemistry teachers who teach this subject. 2, undecided 3,

disagree 4, strongly disagree 5.

TYPE OF DATA AND SCORING PROCEDURE

When responses are scored in this way they yield an

index. In line with the hypothesis on attitudes and their

origins, the type of data collected was nominal except on

career ranking where it was ordinal. The science paper was

scored out of 100, but the ensuing data on science achievement

was treated as ordinal. The pupils who scored between 65 and

100 marks were classified as high achievers. Those who scored

between 50 and 64 marks were classified as moderate achievers while those who scored 49 marks and below were in the low achievers category.

As stated above, a five-point Likert type response mode was used for the attitude questionnaires. A response to a positive statement which indicated the most favourable attitude to science had the highest score and the most unfavourable attitude received the lowest score as example 1 shows. The scores were reversed for the negative statements as shown in example 2 below:-

Example 1: I am much more willing to study science than any other subject.

Strongly agree 5, agree 4, undecided 3, disagree 2, strongly disagree 1.

Example 2: I find it difficult to remember what I have learnt in science.

Strongly agree 1, agree 2, undecided 3, disagree 4, strongly disagree 5.

When responses are scored in this way they yield an individual's attitude score which, as in all attitude scales, places the individual on an "agreement continuum" relating to the attitude in question (Kerlinger, 1970, P.484). These items that were weak or ambiguous were also either omitted or rephrased.

Likert or summated rating attitude scores can then be treated as interval data which can be analysed by t-tests and similar procedures. Questions such as the following proved too difficult and hence were left out.

PILOT STUDY

A pilot study was conducted in order to test out the research instruments. Both the pilot study and data collection were done in the Copperbelt Province. Kitwe Boys' and Helen Kaunda Secondary Schools were selected for the pilot study because they were similar to the actual schools in the study and it was easy to visit them. Questionnaires for parents and teachers were also pretested at the same schools. The pilot study was necessary to identify weak and inappropriate items. Each item was examined to see whether it separated people with favourable attitudes from those with unfavourable attitudes. Any items that did not discriminate between the two groups of people were left out. Below are two examples of items that were omitted as a result of the pilot study.

- "studying science is very important in today's world."
- "science subjects are more suitable for the boys than for girls."

Items that were weak or ambiguous were also either omitted or rephrased.

The science test was also given a trial run. Some parts of the test that proved to be too difficult were left out and others were rewritten. Questions such as the following proved too difficult and hence were left out. was shown especially on the part of some girls. The whole field work took about two

week (a) With the aid of a diagram, explain briefly how you would construct a simple mercury barometer. Show clearly in your diagram the height you would measure to find the atmospheric pressure;

The main analysis was based on the three main hypotheses. The (b) With the aid of a diagram of an hydraulic braking system in a car explain the purpose of the return spring and how the braking force is applied equally on all the four wheels. reference between boys' attitudes and girls' attitudes towards the study of science. This was tested by means of a COLLECTION OF DATA

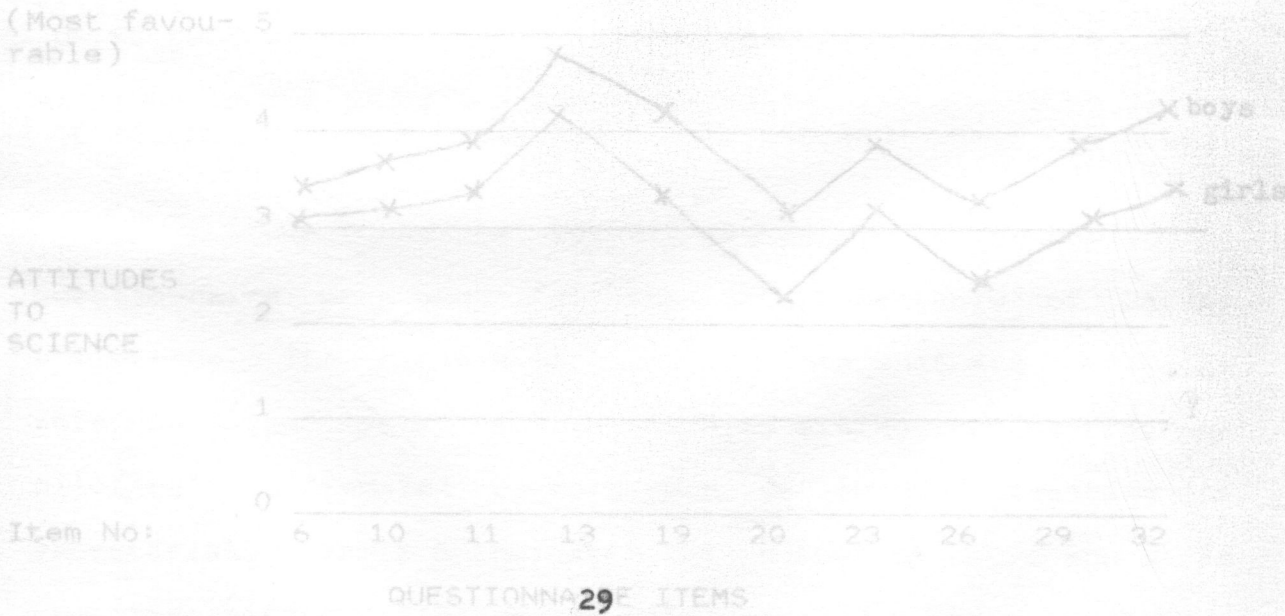
Collection of data involved visits to the various schools in different towns. The first visit to each school involved gathering pupils in one class where they answered questionnaires in about one hour and questionnaires were collected thereafter. girls' Parents' questionnaires were distributed to the pupils to be collected on the second visit when pupils were also required to write a test. As it was not possible to gather teachers in one place (because they were teaching), they answered the questionnaires in their free time. one subhypothesis about correlation between career ranking and gender where the Spearman rank order correlation was used.

The completed questionnaires collected were 200 for pupils (100%), 147 (73% of those sent out) for parents and 51 (85% of those distributed) for teachers. As for the test, all the pupils wrote although some reluctance was shown especially on the part of some girls. The whole field work took about two weeks. The third hypothesis stated that there is no relationship between gender attitudes and pupils' levels of achievement. The first DATA ANALYSIS used the χ^2 test. The analysis of the second subhypothesis regarding a possible relationship between gender and attitudes towards the study of science was based on the three main hypotheses. The first one was to determine whether or not there is a relationship between gender and the attitudes that Grade Twelve boys and girls have towards the study of science. So it stated that there is no difference between boys' attitudes and girls' attitudes towards the study of science. This was tested by means of a t-test.

The second main hypothesis which had a number of subhypotheses was to establish whether or not there was any relationship between selected variables (parents', teachers', peers' attitudes and career preferences) and gender attitudes of Grade Twelve boys and girls towards the study of science. So the broad second hypothesis stated that there is no relationship between each of the selected variables and gender attitudes of Grade Twelve boys and girls towards the study of science. This was tested by means of t and χ^2 tests, except for one subhypothesis about correlation between career ranking and gender where the Spearman rank order correlation was used.

The third and last hypothesis, which had two subhypotheses, was firstly to determine whether or not levels of achievements of boys and girls differ from each other. Secondly it was to compare girls' attitudes to their performance and boys' attitudes to their performance. Therefore the third hypothesis stated that there is no relationship between gender attitudes and pupils' levels of achievement. In the first section of the chapter the results are presented. In the second section, they are analysed statistically and interpreted according to the hypotheses. The first main objective was to establish possible gender attitudes to science using items number 6, 10, 11, 13, 19, 20, 23, 26, 29, 32 in the pupils' questionnaire (Appendix A). The overall result shown by figure 1 was that boys have more favourable attitudes to science than girls, the mean attitude score for boys being 3.85 (SD=0.45) while that for girls was 3.45 (SD=0.64).

Figure 1: ATTITUDES OF BOYS AND GIRLS TO SCIENCE



CHAPTER 4

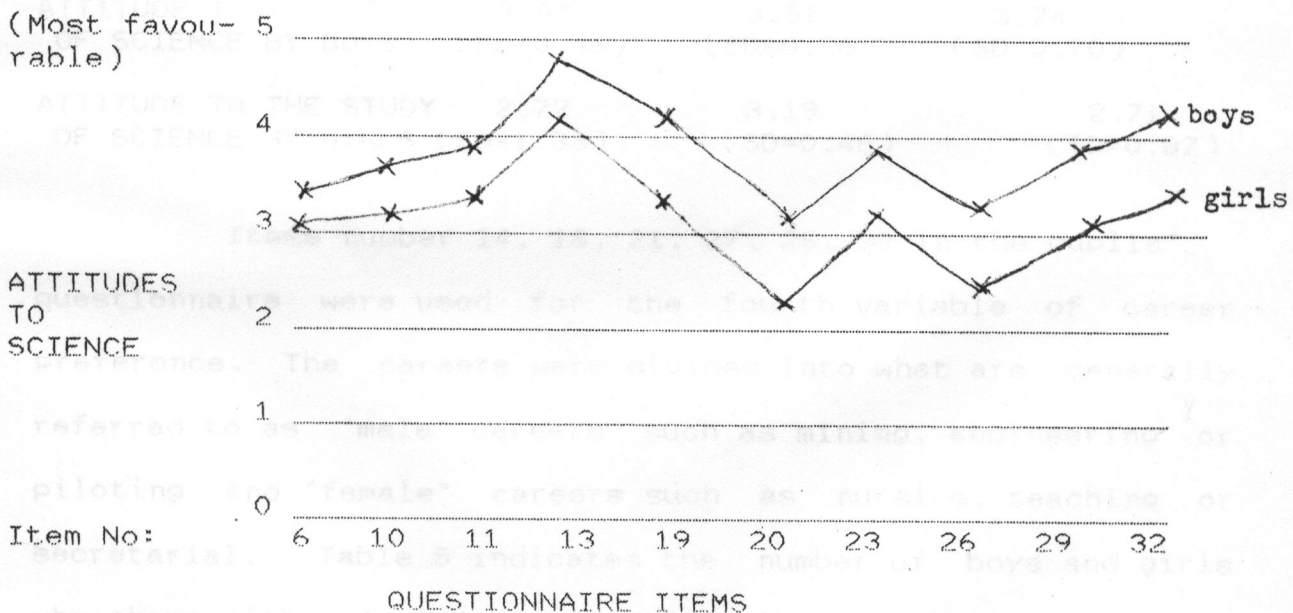
RESULTS

This chapter outlines and analyses the findings of the study according to the three main objectives and related hypotheses.

PRESENTATION OF RESULTS

In the first section of the chapter the results are presented. In the second section, they are analysed statistically and interpreted according to the hypotheses. The first main objective was to establish possible gender attitudes to science using items number 6, 10, 11, 13, 19, 20, 23, 26, 29, 32 in the pupils' questionnaire (Appendix A). The overall result shown by figure 1 was that boys have more favourable attitudes to science than girls, the mean attitude score for boys being 3.85 (SD=0.65) while that for girls was 3.45 (SD=0.64).

Figure 1: ATTITUDES OF BOYS AND GIRLS TO SCIENCE



The second main objective was to investigate the origins of pupils' attitudes, looking at four variables. The variables of parents and teachers were dealt with using parents' and teachers' questionnaires (appendices B and C) respectively while items 3, 7, 12, 24 in the pupils' questionnaire were used for the peers' variable (Appendix A). The overall result for the above variables was that parents, teachers and peers all have more favourable attitudes to the boys' study of science than to the girls' study of science. Table 4 shows the mean scores and standard deviations for the parents', teachers' and peers' attitudes to the study of science by girls and boys.

TABLE 4: MEAN SCORES AND STANDARD DEVIATIONS FOR THE PARENTS', TEACHERS' AND PEERS' ATTITUDES TO THE STUDY OF SCIENCE BY GIRLS AND BOYS.

	PARENTS	TEACHERS	PEERS
ATTITUDE TO THE STUDY OF SCIENCE BY BOYS (SD=0.46)	3.63	3.51 (SD=0.26)	3.74 (SD 0.70)
ATTITUDE TO THE STUDY OF SCIENCE BY GIRLS (SD=1.33)	2.72	3.19 (SD=0.48)	2.71 (SD=0.87)

Items number 14, 18, 21, 27, 28, 30 in the pupils' questionnaire were used for the fourth variable of career preference. The careers were divided into what are generally referred to as "male" careers such as mining, engineering or piloting and "female" careers such as nursing, teaching or secretarial. Table 5 indicates the number of boys and girls who chose either 'male' or 'female' careers. The total number

FIGURE 2: RELATIONSHIP BETWEEN ATTITUDES AND PERFORMANCE

of boys and girls who indicated their careers was less than 100 in each case because some did not indicate the careers. The overall result was that boys prefer to do 'male' careers and girls prefer to do 'female' careers as Table 5 shows.

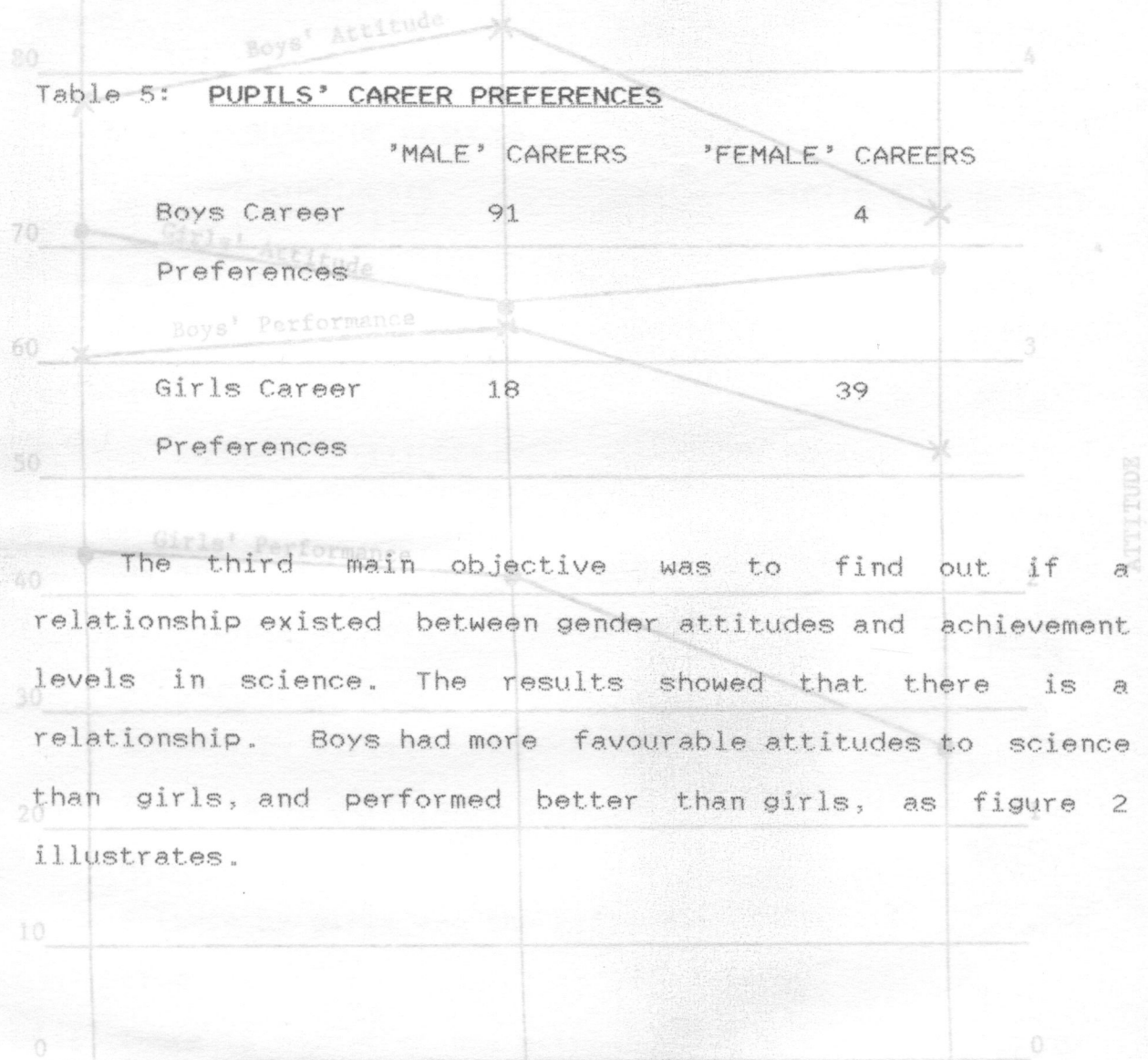


Table 5: PUPILS' CAREER PREFERENCES

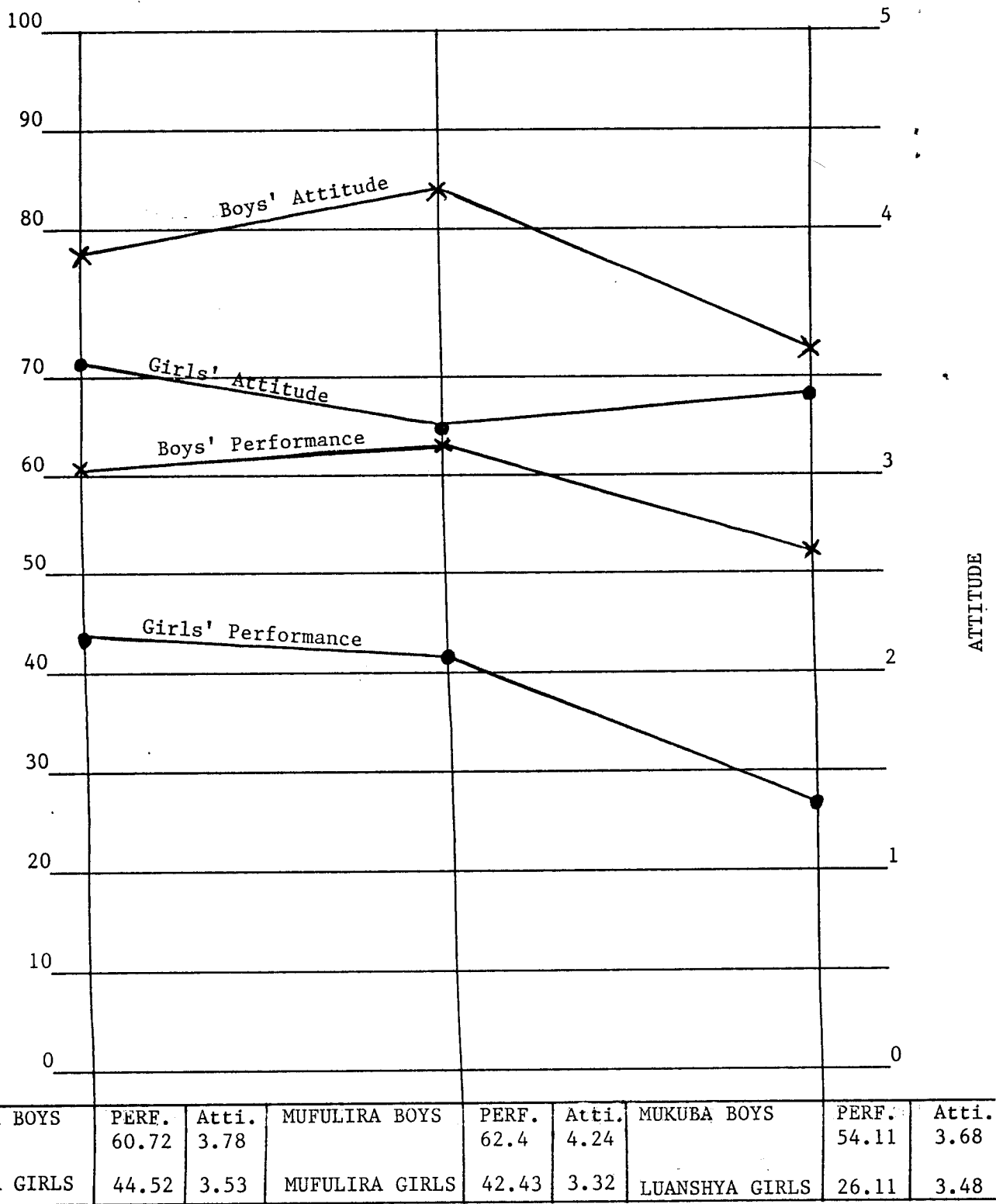
	'MALE' CAREERS	'FEMALE' CAREERS
Boys Career Preferences	91	4
Girls Career Preferences	18	39

The third main objective was to find out if a relationship existed between gender attitudes and achievement levels in science. The results showed that there is a relationship. Boys had more favourable attitudes to science than girls, and performed better than girls, as figure 2 illustrates.

REGIONAL GROUP	PERF.	Attl.	REGIONAL GROUP	PERF.	Attl.	REGIONAL GROUP	PERF.	Attl.
NGOLA BOYS	60.72	3.78	MUPULIRA BOYS	62.4	4.24	MUKURA BOYS	54.11	3.68
NGOLA GIRLS	44.52	3.53	MUPULIRA GIRLS	42.43	3.32	LUANSHYA GIRLS	26.11	3.48

KEY
 x = boys
 o = girls

FIGURE 2: RELATIONSHIP BETWEEN ATTITUDES AND PERFORMANCE



KEY

X = boys

● = girls

ANALYSIS OF RESULTS

Table 6 gives a detailed summary of the statistical results of all the hypotheses examined in the study. These statistical outcomes are examined in detail on subsequent pages.

TABLE 6: SUMMARY OF RESULTS

<u>HYPOTHESIS</u> <u>PUPILS' ATTITUDES</u>	STATISTICAL OUTCOME
There is no difference between boys' and girls' attitudes to the study of science.	$t = 4.44, p < 0.01$ $t = 2.60, p < 0.05$
<u>PARENTS' ATTITUDES</u>	
i) There is no difference between parents' attitudes to the study of science by boys and their attitudes to the study of science by girls.	$t = 8.27, p < 0.01$ $t = 12.87, p < 0.01$
ii) There is no difference between parents' attitudes to the study of science by girls and the attitudes of girls to the study of science.	$t = 5.32, p < 0.01$ $t = 1.14, p > 0.05$
iii) There is no difference between parents' attitudes to the study of science by boys and the attitude of boys to the study of science.	$t = 2.75, p < 0.05$ $t = 7.40, p < 0.01$
<u>TEACHERS' ATTITUDES</u>	
i) There is no difference between Career preference is independent of gender	$t^2 = 4.00, p < 0.01$ $\chi = 72.34, p < 0.001$

- teachers' attitudes to the study of science by girls and their attitudes to the study of science by boys. $\chi^2 = 1.68, p > 0.05$
- ii) There is no difference between teachers' attitudes to the study of science by boys and the attitudes of boys to the study of science. $t = 3.64, p < 0.01$
- iv) There is no correlation between career liking and gender. $\rho = 0.1, n = 10$
- iii) There is no difference between teachers' attitudes to the study of science by girls and the girls' attitudes to the study of science. $t = 2.60, p < 0.05$
- i) Pupils' achievement in science. $\chi^2 = 47.92, p < 0.001$
- ii) There is a strong positive correlation between gender and science and. $\rho = 0.94, n = 6$

PEERS' ATTITUDES

- i) There is no difference between peers' attitudes to the study of science by boys and their attitudes to the study of science by girls. $t = 12.87, p < 0.01$
- ii) There is no difference between peers' attitudes to the study of science by boys and boys' attitudes to the study of science. $t = 1.14, p > 0.05$
- iii) There is no difference between peers' attitudes to the study of science by girls and girls' attitudes to the study of science. $t = 7.40, p < 0.01$

CAREER PREFERENCE

- i) Career preference is independent of gender. $\chi^2 = 72.34, p < 0.001$

Figure 1 (page 30 above) which shows that girls' attitudes are

ii) Girls' attitudes to the study of science are independent of their career preferences. $\chi^2 = 1.68, p > 0.05$

iii) Boys' attitudes to the study of science are independent of their career preferences. $\chi^2 = 0.13, p > 0.05$

iv) There is no correlation between career liking and gender. $\rho = 0.1, n = 10$

PUPILS' LEVELS OF ACHIEVEMENT

i) Pupils' achievement in science is independent of their gender. $\chi^2 = 47.92, p < 0.001$

ii) There is no relationship between gender attitudes to science and achievement in science. $\rho = 0.94, n = 6$

MAIN HYPOTHESIS ONE

On the first objective of establishing possible gender attitudes to science, the hypothesis was that there is no difference between boys' attitudes and girls' attitudes towards the study of science, or attitudes are independent of gender. The mean attitude score for boys was 3.85 (SD = 0.65) and for girls it was 3.45 (SD = 0.64). The statistical outcome was $t = 4.44, p < 0.01$. Hence the hypothesis of no difference between the means was rejected. In other words, boys show a more favourable attitude to science (mean score 3.85) than girls (mean score 3.45). This finding appears clearly in the mean score for the attitudes of girls towards the study of

figure 1 (page 30 (above) which shows that girls' attitudes are less favourable than those of boys on every attitude item. $p < 0.01$. Here also the null hypothesis was rejected. The attitudes of parents **MAIN HYPOTHESIS TWO** science by girls is significant. This hypothesis encompasses several subhypotheses regarding the genesis of pupils' attitudes.

Subhypothesis III: VARIABLE 1: PARENTS

Subhypothesis I:

This part of the study investigated whether or not there was any relationship between parents' attitudes and their childrens' attitudes. The first subhypothesis states that there is no difference between parents' attitudes towards the study of science by boys and by girls. The mean score for parents' attitudes towards the study of science by boys was 3.63 (SD = 0.46) while for parents' attitudes towards the study of science by girls it was 2.72 (SD = 1.33). There is a significant difference between these means, $t = 8.27$, $p < 0.01$. Hence the null hypothesis was rejected. Parents' attitudes to the study of science by boys are significantly more favourable than their attitudes to the study of science by girls.

VARIABLE 2: TEACHERS

Subhypothesis II: This variable, the purpose was to find out if teach. The second element of the hypothesis was that there is no difference between girls' attitudes to the study of science and parents' attitudes to the study of science by girls. The mean score for the attitudes of girls towards the study of

science was 3.45 (SD = 0.64) while for parents' attitudes it was 2.72 (SD = 1.33). In this case the t value is 5.32, $p < 0.01$. Here also the null hypothesis was rejected. The attitudes of parents to the study of science by girls is significantly less favourable than the attitudes of girls themselves.

Subhypothesis III:

The third and last component of the hypothesis about parents was that there is no difference between parents' attitudes to the study of science by boys and boys' attitudes towards the study of science. The mean score for parents' attitude towards the study of science by boys was 3.63 (SD = 0.46) while the mean score for boys' attitudes to the study of science was 3.85 (SD = 0.65). In this case the calculated t value was 2.75, $p < 0.05$. Again the null hypothesis was rejected. Boys' attitudes to the study of science are more favourable than parents' attitudes to the study of science by boys, but the difference between the boys' and parents' attitudes is not as marked as in the case of girls.

VARIABLE 2: TEACHERS

As regards this variable, the purpose was to find out if teachers' attitudes to the study of science by pupils differ according to the pupils' gender and if there are possibilities of a link between teachers' attitudes and pupils' attitudes to the study of science.

Subhypothesis I:

This subhypothesis stated that there is no difference between teachers' attitudes to the study of science by girls and by boys. From the total scores of every teacher, the calculated mean score for teachers' attitudes to the study of science by girls and by boys were 3.19 (SD = 0.48) and 3.51 (SD = 0.26) respectively, $t = 4.00$, $p < 0.01$. Thus the null hypothesis was rejected. In other words, teachers' attitudes to the study of science by boys are significantly more favourable than they are to the study of science by girls.

Subhypothesis II

The second subhypothesis about teachers' attitudes stated that there is no difference between teachers' attitudes to the study of science by boys and boys' attitudes to the study of science. The mean score for teachers' attitude to the study of science by boys was 3.51 (SD = 0.26) while the mean score for boys' attitudes to the study of science was 3.85 (SD = 0.65), $t = 3.64$, $p < 0.01$. The null hypothesis was rejected. In other words boys' attitudes to the study of science are more positive than appear in teachers' attitudes to the study of science by boys.

Subhypothesis III

A similar hypothesis about girls was also tested. The mean score for teachers' attitudes to the study of science by girls was 3.19 (SD = 0.48) while for girls' attitudes to the study of science it was 3.45 (SD = 0.64). The t value was

2.60, $p < 0.05$. Hence the null hypothesis of no difference between teachers' attitudes to the study of science by girls and girls' attitudes to the study of science was rejected. This means girls have a more positive attitudes to the study of science than appear in teachers' attitude to the study of science by girls. and 3.74 (SD = 0.70) for peers' attitudes to the study of science by boys, $t = 1.14$, $p > 0.05$. In this case the null hypothesis is not rejected.

VARIABLE 3: PEERS (boys and girls) There is no evidence to suggest that the attitudes of the Grade Twelve boys. Regarding this variable, the objective was to find out if peers' attitudes to the pupils' study of science depend on whether the pupils are boys or girls. In other words do peers' attitudes to the pupils' study of science depend on pupils' gender? The second purpose was to investigate if there are possibilities of a link between peers' attitudes and pupils' attitudes to the study of science. The mean score for peers' attitudes to the study of science by boys was 3.43 (SD = 0.64) and 2.71 (SD = 0.87) was the mean score for peers' attitudes to the study of science by girls.

Subhypothesis I The first subhypothesis on peers stated that there is no difference between peers' attitudes to the study of science by boys and to the study of science by girls. In this case the mean score for peers' attitudes to the study of science by boys was 3.74 (SD = 0.70) and the mean score for peers' attitudes to the study of science by girls was 2.71 (SD = 0.87), $t = 12.87$, $p < 0.01$. The null hypothesis was rejected. Peers' attitudes to the study of science by boys are significantly more favourable than they are for girls. different from each other and secondly if there is a relationship

between career preferences and pupils' attitudes to the study of science.

Subhypothesis II

The second subhypothesis was that there is no difference between peers' attitudes to the study of science by boys and boys' attitudes to the study of science. The mean scores compared were 3.85 (SD = 0.65) for boys' attitudes to the study of science and 3.74 (SD = 0.70) for peers' attitudes to the study of science by boys, $t = 1.14$, $p > 0.05$. In this case the null hypothesis was not rejected. There is no evidence to suggest that the attitudes of the Grade Twelve boys and the attitudes of their peers to the study of science by boys are different.

Subhypothesis III

A similar hypothesis about girls was also tested. Unlike in case of the boys the difference between the mean scores was large. The mean score for girls' attitude to the study of science was 3.45 (SD = 0.64) while 2.71 (SD = 0.87) was the mean score for the peers' attitudes to the study of science by girls, $t = 7.40$, $p < 0.01$. The null hypothesis is rejected: girls themselves have an attitude towards the study of science that is significantly more favourable than the attitude their peers have for them.

VARIABLE 4: CAREER PREFERENCE

On this variable, the objectives were to investigate firstly if career preferences of boys and girls are different from each other and secondly if there is a relationship

between career preferences and pupils' attitudes to the study of science.

Subhypothesis I

The first hypothesis about career preferences stated that careers preferred by girls are the same as those preferred by boys or career preference is independent of gender. To analyse this hypothesis the χ^2 test was employed using the figures in table 5 (page 32 above). The calculated χ^2 value was 72.34, $P < 0.001$. Therefore the null hypothesis that career preference is independent of gender was rejected. Career preference appears to be strongly gender influenced. Boys overwhelmingly prefer what are considered to be 'male' careers, while girls show a strong preference for what are termed 'female' careers.

Subhypothesis II

This subhypothesis stated that girls' attitudes to the study of science are independent of their career preferences. Using the figures in table 7 a χ^2 of 1.68 was obtained, $p > 0.05$. Hence the null hypothesis was not rejected. There is no evidence to show that girls' attitudes to the study of science depend on career preferences. Girls' attitudes to the study of science do not appear to be affected by their career preferences.

TABLE 7: GIRLS' CAREER PREFERENCES AND ATTITUDES

ATTITUDE TO SCIENCE	PREFERRED CAREERS	
	"MALE" CAREERS	"FEMALE" CAREERS
FAVOURABLE	15	26
UNFAVOURABLE	2	10

Subhypothesis III

The third subhypothesis on career preferences stated that boys' attitudes to the study of science are independent of the boys' career preferences. Like in the case of girls the results for boys shown in table 8 were not significant, $\chi^2 = 0.13$, $p > 0.05$. The null hypothesis was not rejected, implying that the boys' attitudes to the study of science are independent of their career preferences.

TABLE 8: BOYS' CAREER PREFERENCES AND ATTITUDES

ATTITUDES TO SCIENCE	PREFERRED CAREERS	
	"MALE" CAREERS	"FEMALE" CAREERS
FAVOURABLE	75	3
UNFAVOURABLE	16	1

Subhypothesis IV

The fourth and last hypothesis on the career preference variable was on career liking and it stated that there is no correlation between career liking and gender. The data in table 9 were used to calculate a Spearman Rank Order Correlation. The calculated value was $\rho = 0.1$ which

indicates that there is very little correlation between pupils' career liking and their gender.

TABLE 9: PUPILS CAREER RANKING

CAREERS	GIRLS' RANK ORDER	BOYS' RANK ORDER
Engineer	5	1

TABLE 10: ACHIEVEMENT IN SCIENCE IN RELATION TO GENDER

CAREERS	GENDER	PUPILS ACHIEVEMENT IN SCIENCE		
		LOW ACHIEVERS	MODERATE ACHIEVERS	HIGH ACHIEVERS
Doctor		3		2
Accountant		2		3
Pilot		8		4
Mechanic	MALE	6	42	29
Teacher	FEMALE	9	89	3
Secretary		7		9
Airhostess		4		9
Nurse		1		10

Using the results of the science examination administered as part of the study, pupils were classified into low achievers (0-49 marks), moderate achievers (50-64 marks), high achievers (65-100 marks), as stated clearly in the last chapter. The outcomes, shown in table 10, were used of a X²-test. The obtained χ^2 value of 47.93 is highly significant $p < 0.001$.

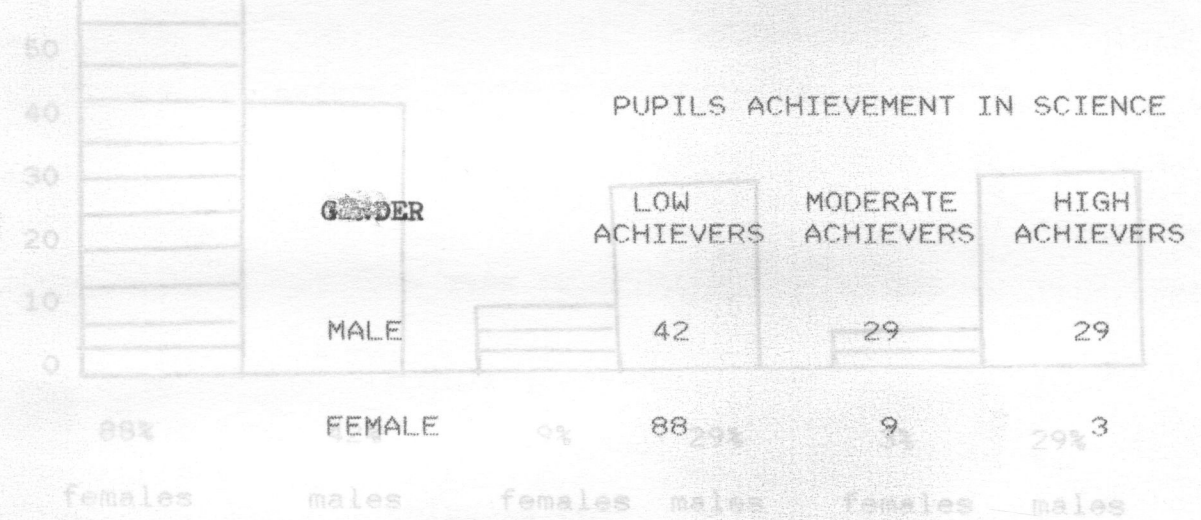
MAIN HYPOTHESIS THREE

On the third objective of investigating whether a relationship existed between pupils' attitudes and achievement in science, the main hypothesis was that there is no relationship between differential gender attitudes and pupils' levels of achievement. It indicates the numbers of female and male pupils in the classified categories of performance in science.

Subhypothesis I PERFORMANCE IN SCIENCE ACCORDING TO GENDER

The first subhypothesis was concerned with finding out whether boys' achievement differs from girls' achievement in science. Hence the hypothesis stated that achievement in science is independent of pupils' gender.

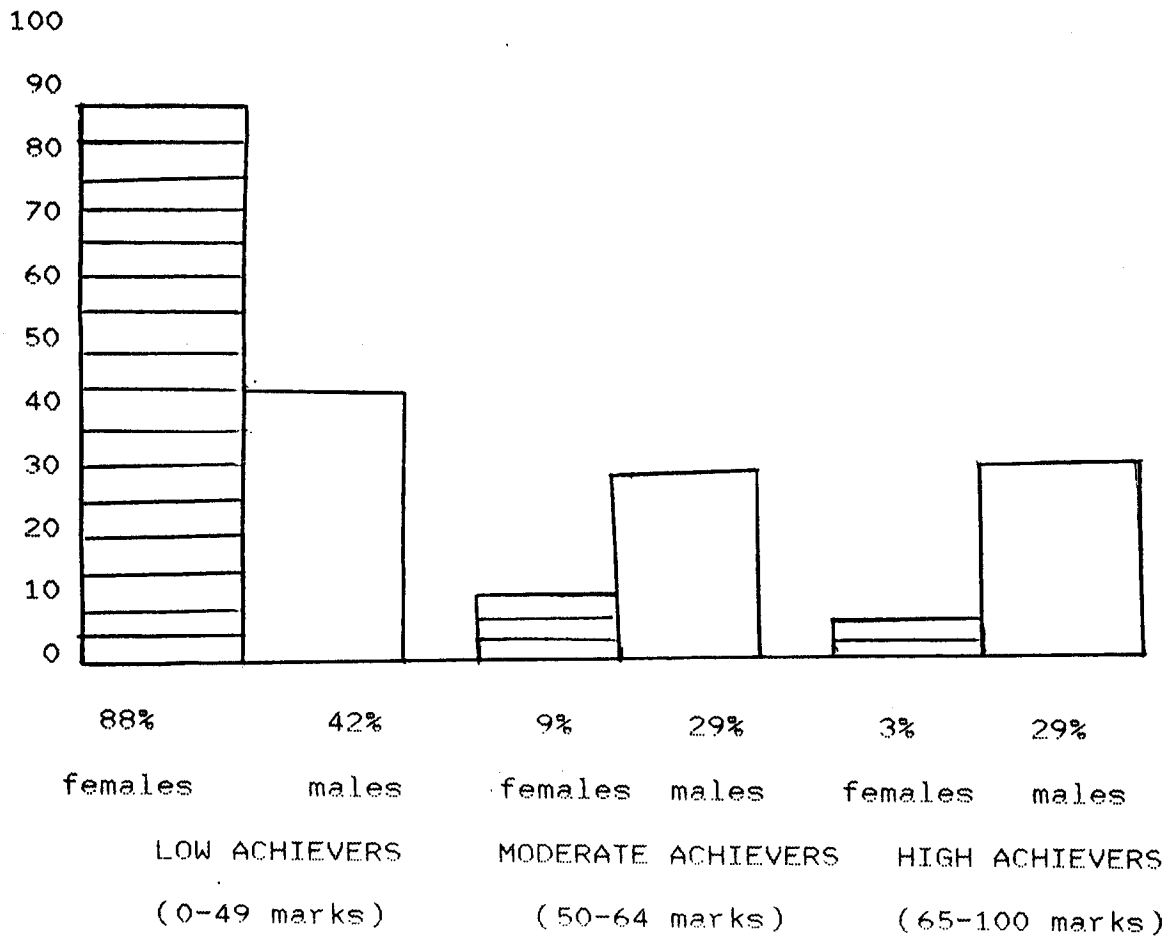
TABLE 10: ACHIEVEMENT IN SCIENCE IN RELATION TO GENDER



Using the results of the science examination administered as part of the study, pupils were classified into low achievers, (0-49 marks), moderate achievers (50-64 marks), and high achievers (65-100 marks). The percentage (88%) of females in the low achievers is more than twice the percentage (42%) of males while the percentage of females in the high achievers is only 3% compared to 29% of males. Even in the moderate achievers category, the females obtained X² value of 47.92 is highly significant p < 0.001. The null hypothesis was rejected: there is a highly significant difference between boys' and girls' achievement in science.

Boys performed better than girls. Figure 3 also depicts the same finding. It indicates the numbers of female and male pupils in the classified categories of performance in science. The average mark for boys in a science.

Figure 3: PUPILS' PERFORMANCE IN SCIENCE ACCORDING TO GENDER



The percentage (88%) of females in the low achievers is more than twice the percentage (42%) of males while the percentage of females in the high achievers is only 3% compared to 29% of males. Even in the moderate achievers category, the females are fewer than males.

One aspect which became apparent, though it was not part of the objectives was that pupils in co-educational schools performed better than those in single sex schools. The figures in table 11 show that the average mark for boys in a

Subhypothesis II

boys only school is below the average for boys in co-educational schools. Similarly, the average mark for girls in a girls only school is below the averages for girls in co-educational schools. This finding is similar to Harveys' (1985) finding that girls and boys in mixed-sex groups had slightly more positive attitudes to practical science than those in single-sex groups.

BETWEEN GENDER ATTITUDES TO THE STUDY OF SCIENCES AND ACHIEVEMENT IN SCIENCE

TABLE 11: AVERAGE SCIENCE ACHIEVEMENT BY GENDER AND TYPE OF SCHOOL

RESPONDENTS	TYPE OF SCHOOLS	Rank-Order	AVERAGE PERFORMANCE
BOYS	Mufulira co-educational School	1	62.20
	Chingola Co-educational School	2	60.72
	Mukuba Single-Sex School	3	54.11
	Chingola Sec. Sch.	4	
	Mufulira Sec. Sch.	5	
GIRLS	Luanshya Single-Sex School	5	26.11
	Chingola Co-educational School	4	44.52

The Mufulira Co-educational = 0.94 which indicates that there is a very significant relationship between attitude and performance. This implies that the more favourable the attitudes the better the performance and the less favourable the attitudes the poorer the performance. These findings also appear clearly in figure 2 (page 33 above). According to figure 2, the general trend shown for both boys and girls is that the more favourable the attitude the better the

Subhypothesis II

For the second hypothesis, which stated that there is no relationship between gender attitudes and pupils' levels of achievement, the study compared both girls' and boys' attitudes with their performance in science. The data in table 12 was used to calculate a Spearman Rank Order Correlation. Figure 2 also shows that the girls' attitudes are less favourable than the boys' attitudes and the girls' performance is poorer than that of the boys.

TABLE 12: A COMPARISON BETWEEN GENDER ATTITUDES TO THE STUDY OF SCIENCES AND ACHIEVEMENT IN SCIENCE

RESPONDENTS	Rank-Order	
	Science Achievement	Attitude to the Study of Science
Boys of Mufulira Sec. Sch.	1	1
Boys of Chingola Sec. Sch.	2	2
Boys of Mukuba Sec. School	3	3
Girls of Chingola Sec. Sch.	4	4
Girls of Mufulira Sec. Sch.	5	6
Girls of Luanshya Sec. Sch.	6	5

The calculated value was $\rho = 0.94$ which indicates that there is a very significant relationship between attitude and performance. This implies that the more favourable the attitudes the better the performance and the less favourable the attitudes the poorer the performance. These findings also appear clearly in figure 2 (page 33 above). According to figure 2, the general trend shown for both boys and girls is that the more favourable the attitude the better the

performance and the less favourable the attitude the poorer the performance (except for Luanshya girls that are the least in performance but come second last in attitude). Similarly,

figure 2 also shows that the girls' attitudes are less favourable than the boys' attitudes and the girls' performance is poorer than that of the boys,

should be noted at the outset that all of the null hypotheses except two have been rejected. In other words the study confirms most of the hypotheses and questions raised in the introduction.

PUPILS' ATTITUDES TO THE STUDY OF SCIENCE

The difference between the MEAN attitude score for boys ($M=3.85$, $SD = 0.05$) and girls ($M=3.45$, $SD = 0.64$) was found to be statistically significant and the null hypothesis of no difference between boys' attitudes and girls' attitudes to science was hence rejected. This means that boys have more favourable attitudes to science than girls. Figure 1 shows that on every item, girls' attitudes are less favourable than those of boys. Items 29, 26 and 20 show remarkable differences between girls' and boys' attitudes to science. On item number 29, while only 55% of girls disagreed with the statement that science is difficult for them, 82% of boys did so. This implies that more than three quarters of boys as compared to only slightly more than half of the girls think that science is not difficult for them. Similarly 64% of the girls agreed with item number 20 which states that 'subjects

such as English and Geography are "easier for me than science is" and only 32% disagreed. CHAPTER 5 contrary, only 38% of boys agreed and 62% disagreed. This shows that more girls than boys think they

DISCUSSION AND RECOMMENDATIONS

This chapter discusses and summarises the findings of the study. It also gives recommendations on the problem. It should be noted at the outset that all of the null hypotheses except two have been rejected. In other words the study confirms most of the hypotheses and questions raised in the introduction.

PUPILS' ATTITUDES TO THE STUDY OF SCIENCE

The difference between the MEAN attitude score for boys ($M=3.85$, $SD = 0.05$) and girls ($M=3.45$, $SD = 0.64$) was found to be statistically significant and the null hypothesis of no difference between boys' attitudes and girls' attitudes to science was hence rejected. This means that boys have more favourable attitudes to science than girls. Figure 1 shows that on every item, girls' attitudes are less favourable than those of boys. Items 29, 26 and 20 show remarkable differences between girls' and boys' attitudes to science. On item number 29, while only 55% of girls disagreed with the statement that science is difficult for them, 82% of boys did so. This implies that more than three quarters of boys as compared to only slightly more than half of the girls think that science is not difficult for them. Similarly 64% of the girls agreed with item number 20 which states that "subjects

such as English and Geography are easier for me than science is" and only 32% disagreed. On the contrary, only 38% of boys agreed and 56% disagreed. This shows that more girls than boys think they would do better in arts subjects than in science. On item number 26, 48% of girls as compared to 33% of boys agreed to the statement "I approach science with a feeling of hesitation, resulting from a fear of not being able to do well." attitudes to the study of science by boys (mean score 3.63 SD = 0.46) than they had to the study of science by girls. In the light of the above results, it is legitimate to infer that there is a significant difference between boys' and girls' attitudes to the study of science, with boys having more positive attitudes than girls. This finding is in accord with such western studies as those by Harvey (1985), Warburton and Jenkins (1983) and Hamilton (1982) who also found that, on average, boys had a more favourable attitude to science than girls.

In the African and Zambian context, as mentioned earlier, there are some studies that have reported similar findings. In Botswana and Swaziland, Clegy and Duncan (1985) and Wheldon and Smither (1987) found that girls had more favourable attitudes towards art subjects than towards sciences. A similar picture is reflected in Malawi and Zambia. The Zambian girls who were studied by Shifferraw (1982) showed more interest in Homecraft than in science which they thought was more useful to boys than to them. However, the difference between parents' attitudes to

THE GENESIS OF PUPILS' ATTITUDES

(a) The Role of Parents in the Formation of Attitudes to the Study of Science

The hypothesis which stated that parents have the same attitudes to the study of science by boys and by girls was rejected. The results showed that parents had remarkably more favourable attitudes to the study of science by boys (mean score 3.63 SD = 0.46) than they had to the study of science by girls (mean score 2.72 SD = 1.33). This could imply that parents would like to see more boys than girls get scientific knowledge and be in the science fields. This finding reinforces and to some extent lies at the root of the generally held belief that science is a man's field which is too difficult for a girl. Studies by Shifferraw (1982), Datta (1984), Kaminski (1985) and Munachonga (1985) have documented this belief.

The hypothesis of no difference between boys' attitudes (mean score 3.85 SD = 0.65) and parents' attitudes to the study of science by boys (mean score 3.63 SD = 0.46) and that of no difference between girls' attitudes (mean score 3.45 SD = 0.64) and parents' attitudes to the study of science by girls (mean score 2.72 SD = 1.33) were both rejected. In both cases the parents' average attitude scores were lower than those of boys and girls. This implies that both boys and girls have a more favourable attitude to science than parents have for them. However, the difference between parents' attitudes to

gender roles. Parents also make statements that seem to be

the study of science by girls and the girls' attitudes to science (0.73) is considerably greater than the difference between parents' attitudes to the study of science by boys and boys' attitudes to the study of science (0.25). girls do not perform as poorly as girls or not to do what are labelled as If parents have attitudes that are almost negative to the study of science by girls, it is not surprising that girls develop less favourable attitudes to science than boys. The first and most influential individuals in a child's life are the parents. It is through parents that much of the culture of society is passed on to the next generation. This culture includes attitudes, values, beliefs, feelings and behaviour. According to Michel (1986), children come to identify themselves as boys and girls and as different from each other in the home, where they first experience gender stereotypes. From the time they are born children are treated differently according to their gender. "In many countries the birth of a baby boy is celebrated but that of a girl is greeted with silence" (Michel, 1986 p.18). In most western countries and in some developing countries parents buy girls toys such as dolls, miniature spoons, pots, plates, or sewing machines that relate to home-keeping while they buy boys mechanical toys and games or construction sets that develop different skills, learnt in science. Therefore, differential attitudes of boys and girls In many homes, the father is seen as exercising more power than the mother and the sexist division of labour in the home is significant in the children's perception of their gender roles. Parents also make statements that seem to be

simple and innocent but which, because of their gender stereotyping, have a great impact on the children's personalities. For instance, parents tell their sons not to cry as much as girls, not to fear things the way girls do, not to perform as poorly as girls or not to do what are labelled as girls' subjects. On the other hand, girls are told to be humble, not to behave aggressively like boys, not to involve themselves in heavy physical work, or not to do hard subjects that are 'fit' for boys. As children learn, imitate and internalise these ideas, behaviour patterns, values, and attitudes of the adult world around them, they come to accept and believe that males are superior and females are inferior in almost every aspect of life. Therefore boys tend to have a more positive self-image which, among other things, leads to more positive attitudes to science. On the contrary, girls develop a negative self-image that leads to less positive or almost negative attitudes to science. These appear in the present study where most of the girls agreed to such stereotyped statements as: "science is difficult for girls," "I approach science with a feeling of hesitation, resulting from a fear of not being able to do well," or "I find it difficult to remember what I have learnt in science." Therefore, differential attitudes of boys and girls are due in large part to the differential expectations of parents as shown by the parents' responses.

(b) This The Role of Teachers in the Formation of Attitudes
product to the study of Science school and teachers form an
integral part of society. they exhibit the exist attitudes
towardThe hypothesis of no difference between teachers'
attitudes to the study of science by girls and boys was
rejected. Teachers' attitudes to the study of science by boys
were significantly more favourable (mean score 3.51, SD =
0.26) than their attitudes to such study by girls (mean score
3.19, SD = 0.48). Less favourable attitudes of teachers to
the study of science by girls are illustrated in a few
examples. All but nine teachers (17.6%) disagreed with the
statement that teaching girls is easier than teaching boys.
Thirty one teachers (60%) agreed that they would encourage
boys more than girls to be engineers and thirty three teachers
(64.7%) concurred that boys seem to be more hardworking than
girls in science.

Despite the constitutional position that there should be no
discrStudies in Zambia and elsewhere support this finding.
Dale (1974) and Johnstone (1974) found that science teachers'
attitudes have an influence on pupils and that girls are more
influenced by teachers than boys. Shifferraw's study (1982)
also shows that teachers have a negative attitude to the
girls' study of science for they emphasise the weakness of
girls in science. Similarly, Serpell (1987) found that
teachers emphasised literacy and local economy skills as
educational goals for boys while they emphasised domestic
skills for girls.

This attitude of science teachers towards girls is the product of society. As the school and teachers form an integral part of society, they exhibit the sexist attitudes towards girls and women that prevail in the wider society. Like parents, teachers instil in children social values, behaviour, feelings, beliefs and attitudes. Their expectations for girls, as the present and other studies have shown, are that girls will be weak in subjects such as science. In the present study several teachers indicated that:

(a) they would encourage boys more than girls to do engineering;

(b) teaching boys is easier than teaching girls;

(c) boys seem to be more hardworking in science than girls.

Despite the constitutional position that there should be no discrimination in access to educational opportunities on the grounds of gender, some teachers discourage girls from doing the "hard" sciences such as physics, chemistry and physical science. Teachers are sometimes heard giving girls such "advice" as "you will not manage in physics" or biology is better for you." These negative attitudes of teachers, innocent as they may look, create in girls a significantly self-confidence and a negative or a less positive attitude to science. This indicates that peers, just like parents and teachers, have a less favourable attitude to the study of science by girls. The implication is that they would rather see more boys than girls in science and technological

The hypotheses of no difference between boys' attitudes to the study science (mean score 3.85, SD = 0.65) and teachers' attitudes to the study of science by boys (mean score 3.51, SD = 0.26) and that of no difference between girls' attitudes to study of science (mean score (3.45 SD=0.64) and teachers' attitudes to the study of science by girls (mean score 3.19 SD = 0.48) were also rejected. As in the case of parents, both boys and girls have a more favourable attitude to science than teachers have for them. However, the apparent difference between teachers and parents is that teachers' attitudes to the study of science by girls (mean score 3.19) are not as unfavourable as those held by parents (mean score 2.72). Also the difference between teachers' attitudes to the study of science by girls (mean score 3.51) and to the study of science by girls (mean score 3.19) is not as wide as was the case with parents.

(c) The Role of Peers (Boys and Girls) in the Formation of Attitudes to Science

The hypothesis of no difference between peers' (boys and girls) attitudes to the study of science by boys and girls was rejected. The attitudes of peers to the study of science by boys (mean score 3.74, SD = 0.70) were significantly more favourable than their attitudes to its study by girls (mean score 2.71, SD = 0.87). This indicates that peers, just like parents and teachers, have a less favourable attitude to the study of science by girls. The implication is that they would rather see more boys than girls in science and technological

Thus, both female and male peers, like anyone else in areas. The peers' attitudes (mean score 2.71) are almost the same as parents' attitudes (mean score 2.72) and much lower than the teachers' attitudes (mean score 3.19) to the study of science by girls.

Unlike other hypotheses, the hypothesis of no difference between peers' attitude to boys' study of science and boys' own attitudes to the study of science was not rejected. The results showed that there is no evidence to suggest that the attitudes of the Grade Twelve boys (mean score 3.85) and the peers' attitude to the boys' study of science (mean score 3.74) are different. Both boys and their peers seem to share the same fairly favourable attitudes.

The rejection of the third hypothesis of no difference between girls' attitudes to the study of science (mean score 3.45, SD = 0.64) and peers' attitudes to the study of science by girls (mean score 2.71, SD = 0.87) implies that peers have less favourable attitudes to the study of science by girls than girls have towards science. While the peers have a fairly favourable attitude to the study of science by boys (mean score 3.74) they have a far less favourable attitude to the girls' study of science (mean score 2.71).

One clear finding of the study is that career preferences are not independent of gender. In other words most Grade 12

boys (91 out of 100) in the study chose the careers generally

Thus, both female and male peers, like anyone else in society, encourage sexist stereotypes (Michel 1986). The peers' feelings, behaviour, beliefs, values and attitudes are made and shaped by the socialisation that portrays females as inferiors and males as superiors. In the present study, peers have demonstrated how they have internalised this social outlook. For instance, it was found that:

(a) peers would discourage girls more than boys from studying science;

(b) male peers do not feel good if a girl outperforms them in science;

(c) most peers feel engineering is a man's job;

(d) most peers feel that boys are more hardworking in science than girls.

These findings show that the socialisation peers have undergone has taught them that girls are not as 'fit' or as capable as boys in the hard sciences and hence they have a negative attitude to the girls' study of science. Such peers' attitude to some extent contribute to the less favourable attitudes girls have towards the study of science.

(c) The Role of Career Preferences in the Formation of Attitudes to Science

One clear finding of the study is that career preferences are not independent of gender. In other words most Grade 12 boys prefer the 'male' careers and low ranks to the 'female' careers. Apparently the girls also seem to like the male

boys (91 out of 100) in the study chose the careers generally referred to as 'male' careers such as engineering, mechanics or mining. On the other hand, of the 57 girls who indicated their career preferences, 39 chose the so-called 'female' careers such as nursing, teaching or secretarial. This implies that boys would prefer to take up 'male' careers and girls would prefer to take up 'female' careers. Hence career preferences appear to be strongly related to gender.

In the light of these findings one could say that boys like male careers and that those are the careers they would like to do in future. One could also assume that career preferences would contribute to their favourable attitude to science which is a prerequisite for such careers. Girls on the other hand indicated that while they have a liking for 'male' careers just as boys do, they intend to follow 'female' careers. This gives reason for believing that girls have realised the importance of the scientific fields but they are still not confident enough to enter them.

The hypothesis that girls' attitudes to science are independent of their career preferences was not rejected. Table 7 gave a X^2 value of 1.68, $p > 0.05$. This implies that girls' attitudes to the study of science appear not to be influenced by career preferences.

Like in the case of girls, the hypothesis which stated that boys' attitudes to the study of science are independent of the boys' career preferences was not rejected. Table 8 gave a X^2 value of 0.13, $p < 0.05$. This implies that the boys' attitudes to the study of science are independent of their career preferences. This means their attitudes to the study of science also appear not to be influenced by career preferences. On the hypothesis of no correlation between career liking and gender, using table 9, the results show that there is an almost negligible correlation ($\rho = 0.1$, $n = 10$). According to the same table, the boys seem to like the 'male' careers more than the 'female' because they gave high ranks to the 'male' careers and low ranks to the 'female' careers. Apparently the girls also seem to like the male

order to fit into conventional stereotyped professions

careers. For instance "being an accountant ranked 2nd in their order of preference, being a doctor 3rd, a lawyer 4th, an engineer 5th and a mechanic 6th." Contrary to the general expectation, they ranked teacher and secretary, which are considered 'female' careers, very low among their career preferences, in 9th and 7th places respectively.

In the light of these findings one could say that boys like male careers and that those are the careers they would like to do in future. One could also assume that career preferences would contribute to their favourable attitude to science which is a prerequisite for such careers. Girls on the other hand indicated that while they have a liking for 'male' careers just as boys do, they intend to follow 'female' careers. This gives reason for believing that girls have realised the importance of the scientific fields but they are still not confident enough to enter them.

Career differentiation according to gender is a well documented topic. It is a worldwide phenomenon that there is a great disparity in participation between men and women in science and technological studies and careers, with women being under-represented. Studies by Bardouille (1982), Achola (1983), Tembo (1983), Kaminski (1985), Munachonga (1985), Michel (1986) all acknowledge this state of affairs. Reference to tables 1 and 2 (pages 2 and 3 above) also confirms this fact. "The sexist images and stereotypes have the formidable power of making girls censor their ambitions and potential and curb their professional goals in order to fit into conventional stereotyped professions

assigning women to subordinate positions and low salaries" (Michel 1986, p.19). The Society has socialised women into believing that the careers suitable for them are 'female' careers such as secretarial, teaching or nursing, while men see themselves as suitable for 'male' careers such as engineering, mining or mechanics. The present study confirms that the Zambian situation is no different from that in other countries. The better the attitudes the better the performance and the less favourable the attitudes the poorer the performance. Thus in Zambia as elsewhere females are grossly under-represented in both studies and employment that involve the "hard" sciences and technology. For instance, since the University of Zambia opened the School of Mines has never enrolled a female student because legislation prohibits women from working underground. Also up to 1991, School of Engineering had enrolled only four female students (University of Zambia Enrollment Data). Similarly, since 1967, when it started operating, up to 1987, Zambia Airways has had only one Zambian female pilot (Lungu 1989).

(d) Pupils' Attitude in Relation to their Achievement in Science (Kins (1983)). In his study Hamilton found that gender difference. The hypothesis which stated that achievement in science is independent of pupils' gender was rejected. Five Boys' performance was significantly better than the performance of girls. Only 12 of the 100 girls got 50 marks and above as compared to 58 boys. Some girls who were in the low achievers category got as few marks as 12. This state of affairs leaves much to be desired, than in physical sciences.

In testing for the existence of a relationship between gender attitudes and achievement in science a highly significant Spearman Rank Order Correlation of $\rho = 0.94$ ($n = 6$) was obtained. This indicates a very significant relationship between attitude and performance. The size of the correlation and figure 2 (page 33 above) show that the more favourable the attitudes the better the performance and the less favourable the attitudes the poorer the performance. Thus it was that boys, who had more favourable attitudes to science than girls, performed better than girls. One of the keys to the problem therefore is proper education. These findings are in accord with those from other studies in Zambia and elsewhere. In the Zambian situation, Shifferraw (1982), and more especially Kellyani (1991), demonstrated that girls performed more poorly than boys in all Grade Seven and in most Grade Twelve subjects, especially science. In the western world, the relationship between attitude and achievement has been demonstrated by Meyer and Denfold (1961), Cronbach (1977), Hamilton (1982), Warburton and Jenkins (1983). In his study Hamilton found that gender differences in the attitudes are closely associated with performance in science. He found that at Form Five level girls had less favourable attitudes, and entered for and passed significantly fewer science subjects than boys. Like Harvey and Edwards (1980) before him, Hamilton also found that women seem to have more positive attitudes and to perform better in biological than in physical sciences. To motivate girls and convince them that they can study science as well as

RECOMMENDATIONS

Some recommendations can be made on the basis of the results obtained. Since according to the findings the stereotyped attitudes to girls exhibited by the socialising agents such as parents, teachers and peers are likely to play an important role in the way girls form their attitudes then the solutions should begin within these socialising agents.

Since parents are the first people children make contact with, one of the keys to the problems therefore is proper education that can penetrate homes and influence parents. The Ministry of Education, either on its own or in conjunction with such institutions as churches, christian organisations and the mass media, can educate parents on the importance of girls being treated equally with boys. For instance, parents can be encouraged to buy mechanical toys and games not only for boys but also for girls. The government through the Ministry of Education should make parents see the need to stop using stereotyping statements that discredit girls and women and to lessen the sexist division of labour that puts girls and boys in different camps.

Through similar programmes, the Ministry of Education could hold seminars and workshops to make teachers aware of the importance of girls' and women's participation in science and technology. Teachers could be encouraged to motivate girls and convince them that they can study science as well as

boys can. It is important also that the career teachers hold talks with girls as early as possible to encourage them to have confidence to take up careers that involve science and technology. The Ministry of Education should also practically ensure that some subjects such as physics, chemistry, science, metal work and homecraft are not offered according to gender.

Apart from educating the public about the importance of girls' and women's participation in science, the Ministry of Education has another great battle, to make sure girls and women themselves have a positive self-image. Females should be made to understand that a positive self-image is one of the keys to good performance, be it in science or other areas (Hamilton 1982). They should be convinced that they are as capable as men. This can be done through public or school meetings, plays, educational tours of industries with women who are engineers, mechanics and technicians. It is also important that women are allowed to take up any career they want. Repealing such "protective" laws as the Employment of Women, Young Persons and Children Act that prevent women from working in areas such as mining, certain manufacturing industries, telephone and telegraphic installations would open up new careers for women.

SIBLIOGRAPHY

ABEL (Advancing Basic Education Literacy Project) 1990 The Economic and Social Impacts of Girls Primary Education in Developing Countries Washington, D.C. USAID.

CONCLUSION

In view of the present study one would conclude that girls and women in Zambia have not yet enjoyed full participation in science and technology due to the negative attitudes inculcated in them by society.

It is probably not an exaggeration to say the development

of people at family, societal and national level depends more heavily on the education of women than on that of men (Datta

1979, ABEL 1980, Summers 1992). This is because the present and the future generations are likely to benefit more through

mothers than fathers. In addition, if women are neglected in science then there would be no harmony in families and the

nation as a whole. Furthermore, it has been asserted that children's interest in science has to be aroused as early as

possible for them to benefit more (Harvey and Edwards 1980). Hence it is wise that women who look after children in homes

and are the majority of teachers in nursery schools be more involved in science than they are now. In view of the above

reasons, it would not be too great an overstatement to say that to a large degree, development is almost synonymous with

the development of women and hence there is need for greater participation of women in science areas.

Hamilton, M.A. 1982. "Jamaican Students' Attitude to Science Examinations." Science Education 66(2): 155-169.

Harvey, T.J. and P. Edwards. 1980. "Children's Expectations and Realisation of Science." British Journal of Educational Psychology 50(3): 266-276.

BIBLIOGRAPHY

- ABEL (Advancing Basic Education and Literacy Project) 1990 The Economic and Social Impacts of Girls Primary Education in Developing Countries Washington, D.C. USAID.
- Achola, P.P.W. 1983. "Some Structural Aspects of Educational Inequality in Zambia." Paper presented at a Research Seminar, School of Humanities and Social Sciences, University of Zambia, Lusaka.
- Bardouille, R. 1984. "Mobility Patterns of the University of Zambia Graduates." Zambia Educational Review 5(1): 10-35.
- Butcher, H.J., and M.B. Pout 1968. "Opinions about Careers Among Scottish Secondary School Children of High Ability." British Journal of Educational Psychology 38(2): 272-279.
- Clegg, A., and W. Duncan. 1985. "Schooling for Girls in Botswana: Education or Domestication?" Working Paper No. 49, N.I.R. University of Botswana, Gaborone.
- Cronbach, L.J. 1977. Educational Psychology. Harcourt Brace Jovanovich, New York.
- Dale, R.R. 1974. "Mixed or Single Sex School." Attainment, Attitudes and Overview 3(1): 160-168.
- Datta, A. 1979. Education and Society. (With Special Reference to Africa) University of Zambia, Lusaka.
- Edwards, A.L. 1957. Techniques of Attitude Scale Construction. New York: Appleton-Century-Crofts, INC.
- Government of the Republic of Zambia (GRZ). 1966. First National Development Plan (1966-1970). Lusaka: Government Printer.
- _____ 1972. Second National Development Plan (1972-1986). Lusaka: Government Printer.
- _____ 1979. Third National Development Plan (1979-1984). Lusaka: Government Printer.
- _____ 1989. Fourth National Development Plan (1989-1993). Lusaka: Government Printer.
- UNES 1970. Laws of the Republic of Zambia. Vol. X, Lusaka: Government Printer.
- Hamilton, M.A. 1982. "Jamaican Students' Attitude to Science Examinations." Science Education 66(2): 155-168.
- Harvey, T.J. and P. Edwards. 1980. "Childrens' Expectations and Realisation of Science." British Journal of Educational Psychology 50(3): 266-276.

- Jahoda, M., and N. Warren. 1966. Attitudes. Penguin Books Ltd, Harmondsworth, Middlesex, England.
- Johnstone, A.H. 1974. "Evaluation of Chemistry Syllabus in Scotland." Studies in Science Education 7(2): 163-172.
- Kamara, I.A. 1978. "Gender Stereotyping: Women and Training Programmes in Science Occupations in Africa." Paper presented at Workshop on Gender Stereotyping Commonwealth Foundation, Accra, 12-16 January 1978.
- Kaminski, D. 1985. "Where are the Female Einsteins?" In Ballamine, H. Schools and Society: A Reader in Education and Sociology. London: Mayfield Publishing Company.
- Kelly, M.J. 1991. Education in a Declining Economy: the Case of Zambia, 1975-1985. Washington, D.C.: World Bank.
- Kelly, M.J., E.B. Nkwanga, L.H. Kaluba, P.P.W. Achola, and K. Nilson. 1986. The Provision of Education for all: Towards the Implementation of Zambia's Educational Reforms under Demographic and Economic Constraints, 1986-2000. Educational Reform Implementation Project. Lusaka: School of Education, University of Zambia.
- Kerlinger, F.N. 1970. Foundations of Behavioural Research. Holt and Winston Rinehart, London.
- Khabele, P.E. 1973. Attitudes and Opinions of Zambia Secondary School Pupils Towards Biology. Unpublished Ph.D. Thesis. Fordham University.
- King, M.E., and M.A. Hill 1991. Women's Education in Developing Countries: Barriers, Benefits and Policy. Background Paper PHREE/91/40. Washington: World Bank.
- Martin, V. 1983. Gender Differentiation in Secondary Education in Zambia. Unpublished B.Phil. Dissertation, University of Birmingham, London.
- Meyer, G.R., and D.H.E. Denfold. 1961. "Factors Associated with Interest in Science." British Journal of Educational Psychology 31(3): 33-37.
- Michel, A. 1986. Down with Stereotypes: Eliminating Sexism for Children's Literature and School Textbooks. Paris: UNESCO.
- Munachonga, M.L. 1988. "The place of Women in National Development, The Role of the University of Zambia." Zambia Educational Review 7(1): 44-56.
- Musgrave, P.W. 1965. The Sociology of Education. Methuen Co. Ltd, London.

Republic of Malawi, 1987. "Gender Stereotyping in Science Technology and Mathematics Education in Malawi: A Country Paper." Paper presented at a Commonwealth Africa Regional Workshop, Accra, 12-16 January 1987. ✓

Serpell, R. 1987. "Teachers, Pupils and Parents in a Rural Area: Experience and Opinions of some Primary School Teachers in Zambia's Eastern Province. Paper presented at Educational Research Bureau Seminar, University of Zambia, Lusaka, March 1987. ✓

Shaw, M.E., and J.M. Wright. 1967. Scales for the Measurement of Attitudes. New York: McGraw-Hill Book Company. ✓

Shifferraw, M. 1982. "Socialisation of Girls in Zambian Secondary Schools: Educational Policy and Practice." Paper presented at a Research Seminar, School of Humanities and Social Sciences, University of Zambia, Lusaka, 3rd March 1982. ✓

Summers, L.H. 1992 "Investing in All the People." Policy, Research and External Affairs Working Paper 905. Washington, D.C.: World Bank ✓

Tembo, L.P. 1983. Men and Women in Text-books: A National Survey on Sex Biases in Zambian Text-books in Primary and Junior Secondary Schools and Their Implications for Education in Zambia. Educational Research Bureau, University of Zambia, Lusaka. ✓

Tuckman, B.W. 1972. Conducting Educational Research. Harcourt Brace Jovanovich, INC. New York. ✓

UNESCO, 1991. World Education Report, Paris: UNESCO Press. ✓

University of Zambia (UNZA) 1991. University of Zambia Enrollment Data Computer Centre, University of Zambia, Lusaka. ✓

Varghese, S. 1987. Views on "STM" Among Girls in Zambia. Ministry of Education, Kitwe.(Mimeo). ✓

Warburton, S.J. and W.L. Jenkins. 1983. "Science Achievement and Attitudes and the Age of Transfer to Secondary School." Educational Research 25(3): 177-183. ✓

Wheldon, A., and A.C. Smith. 1987. "Gender Stereotyping in Science, Technology and Mathematics Education: Gender Based Differences in O-Level Subjects Choice and Performance in Swaziland." Paper presented at a Commonwealth Africa Regional Workshop, Accra, 12-16 January 1987. ✓

Zambia Association for Research and Development (ZARD) 1985. An Annotated Bibliography of Research on Zambian Women. Lusaka. ✓

APPENDIX A

QUESTIONNAIRE FOR PUPILS

GRADE: _____ MALE OR FEMALE _____ SCHOOL: _____

PLEASE ANSWER THE QUESTIONS HONESTLY AND FRANKLY. READ EACH STATEMENT CAREFULLY AND THEN TICK THE ANSWER THAT BEST DESCRIBES YOUR OWN FEELING ABOUT EACH STATEMENT. (PLEASE TICK INSIDE THE BOXES).

1. A sound religious faith is the best thing in life.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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2. The training for doctors involves too much reading.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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3. Some friends do not like me studying science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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4. The practice of birth control is equivalent to murder.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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5. Physical Education makes people think better.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

6. I am much more willing to study science than any other subject.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

7. My male friends do not feel good if a girl performs better than them in science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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8. My friends would be happy if they were in the School of Engineering at UNZA

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

9. Every criminal should be executed.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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10. I would rather participate in a debate than in a science quiz competition.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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11. I find it difficult to remember what I have learnt in science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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12. Most of my friends feel Engineering is a man's job.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

13. A country can develop even without science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

14. Being a miner is suitable for people of my sex.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

15. The learning of mathematics before going to school is not necessary.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

16. My friends find other subjects easier than science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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17. Most of my friends would be happy to marry a science graduate.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

18. Being a pilot would be easy for me.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

19. I could do very well without science.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

29. Science is difficult for me.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

30. I do not have enough confidence in myself to become a lawyer.

20. Subjects such as English and Geography are easier for me than science is.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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21. I would rather be a nurse than a Mechanic.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

22. Physical Education makes people think better?

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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23. I doubt if ideas and concepts I have learnt in science will really help me in my future career.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

24. My friends feel boys seem to be more hardworking in science than girls.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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25. A girl would find being a Mechanic a bit uncomfortable.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

26. I approach science with a feeling of hesitation, resulting from a fear of not being able to do well

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
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27. I like being a Secretary because it is quite easy to train.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

28. Rank the following occupations in terms of your liking for them. Use numbers 1 to 10 with 1 indicating the occupation you like most and 10 indicating the least. Write the numbers in the boxes.

Accountant

Secretary

Mechanic

Medical Doctor

Pilot

Engineer

Teacher

Nurse

Lawyer

Airhostess

29. Science is difficult for me.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

30. I do not have enough confidence in myself to become a lawyer.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

31. I think older employees have fewer accidents on the job.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

32. Science subjects are the most important subjects in schools.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
----------------	-------	-----------	----------	-------------------

Mukwai arubani amuraho yakabonkako muchishinka necine.
 Balengeri bwino bwino ilipusho lino lino lokuluyafwikisha.
 Eyo amunge palyazuko ililimanga ukuti eyo amutamu
 ukulingana ng'efyo amutontokanyo palipusho lino lino.
 (Mukwai congani yakati katubokoshi).

1. Saddam Hussein is a great man.

- Saddam Hussein umuntu umuamirama sana.

strongly agree namunisha sana	agree namuna	undecided nahishibe	disagree nakana	strongly disagree nakanisha sana
-------------------------------------	-----------------	------------------------	--------------------	--

2. A lady would find mechanics a bit uncomfortable

- Umwanakazi kufi amange incito yabu mekanika ukuti teti
 imuamirama sana.

strongly agree namunisha sana	agree namuna	undecided nahishibe	disagree nakana	strongly disagree nakanisha sana
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3. People who study a lot of science do not have respect for traditions

- Abantu abazambilla sana nuli sayansi tabakonko intabi

strongly agree namunisha sana	agree namuna	undecided nahishibe	disagree nakana	strongly disagree nakanisha sana
-------------------------------------	-----------------	------------------------	--------------------	--

4. Boys are more intelligent in science subjects than girls.

- Abana abana baticezajapo ukucila abana abanakeshi mu
 cisambilliro ka sayansi.

strongly agree nasuminisha sana	APPENDIX B	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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PARENTS QUESTIONNAIRE

5. We do not think we have enough confidence in the school of your grade 12 child
 - Lembeni isukulu Lisambililapo umwana wenu Grade 12

IS YOUR CHILD MALE OR FEMALE
 - Umwana wenu grade 12 mwaume nangu mwanakashi

PLEASE ANSWER THE QUESTIONS HONESTLY AND FRANKLY. READ EACH STATEMENT CAREFULLY AND THEN TICK THE ANSWER THAT BEST DESCRIBES YOUR OWN FEELING ABOUT EACH STATEMENT (TICK INSIDE THE BOXES).

Mukwai asukeni amepusho yalakonkapo muchishinka necine. Belengeni bwino bwino liipusho limo limo kokulyumfwikisha. Elyo muconge palyasuko ililelanga ukuti elyo mwaumwa ukulingana ngefyo muletontontokanya palipusho limo limo. (Mukwai congeni mukati katubokoshi).

1. Saddam Hussein is a great man.
 - Saddam Hussein muntu umo uwacindama sana.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
---------------------------------------	-------------------	------------------------	--------------------	--

2. A lady would find mechanics a bit uncomfortable
 - Umwanakashi kuti asanga incito yabu makanika ukuti teti imuwamine sana.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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3. People who study a lot of science do not have respect for traditions
 - Abantu abasambilila sana muli sayansi tabakonka intambi

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
---------------------------------------	-------------------	------------------------	--------------------	--

4. Boys are more intelligent in science subjects than girls.
 - Abana abaume balicenjelapo ukucila abana abanakashi mu cisambililo ca sayansi.

10. Training in the fields of science take too long.
 - Amasambililo yancito yafya asayansi yalalepesha.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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5. We do not think our Grade 12 child has enough confidence to become a lawyer.

- Tatulesubila ukuti umwana wesu uli mu Grade 12 alicetekela ukuti kuti aba Loya wakulubulula imilandu.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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6. Husbands should help wives in the home duties.

- Abalume bafwile ukwafwilishako abakashi muncito shapang'anda.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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7. Highly qualified women in the science fields make proud wives.

- Abanakashi abasambilila sana muli sayansi balayumfwa

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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8. Engineering is a man's job.

- Incito yabu inyiniya nincito yabaume fye.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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9. The training for doctors involves too much reading for our Grade 12 child.

- Teti cilingile umwana wesu uuli mu grade 12 ukucita amasambililo yabu dokota bwamucipatala pantu ilafwaisha ukubelengesa sana.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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10. Training in the fields of science take too long.

- Amasambililo yancito yafya masayansi yalalepesha.

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

11. Policemen's standard of living should be the highest.
- Imikalile isuma yaba kapokola gifwile ukuya pantanshisha

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

12. We doubt if ideas learnt in science will help our grade 12 child in his/her future careers man to be an Engineer than to be a farmer.
- Kwena cakutwishika ngacakuti ifiyo umwana wesu asambilila muli sayansi fikamwafwilisha muncito akengila kuntaanshi fundi

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

13. It is not really necessary for every school child to do easier science for girls than science is.
- Teti cibe ficesakamiko ngacakuti abana bamona Geography tabasambilile sayansiko abakashana ukucila ifizabililo fya

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

14. Female teachers make good mothers.
- Bakafundisha abanakashi bababa niba nyina basuma

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

15. It is more suitable for our grade 12 child to be a nurse than a mechanic [Umwana wesu uuli mu grade 12 kuti camulingilapo ukuba nasi ukucila ukuba makanika.]

strongly agree	agree	undecided	disagree	strongly disagree
strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana

16. Fathers are usually not kind parents.
- Iilingi line bawishi tababa abafyashi baluse iyo.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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17. Passangers would not have as much confidence in a woman Pilot as they would have in a pilot who is a man.
- Abantu abali palwendo teti bacetekele sana kensha wandeke umwanakashi ngefyo bengacetekela kensha wandeke umwaume.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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18. It is much better for a man to be an Engineer than to be teacher.
- Cisumapo umwaume ukuba injiniya ukucila ukuba kafundish

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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19. Subjects such as English, History, Geography are easier for girls than science is.
- Ifisambililo fya Cisungu, History na Geography fyalyangukilako abakashana ukucila ifisambililo fya sayansi.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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20. A woman scientist's preoccupation of her work leaves her with only very little time for her family duties.
- Incito yabu sayantist nincito iyi fwaisha ukubombesha icakuti banamayo basayantist teti bakwate inshita iyi kulu iyakubomba incito shapang'anda.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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21. Most girls do not have the courage to be Miners.
- Abakashana abengi tabakwata ukushipa ukwingalenga ukuti bengile incito yabushi maini.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanis sana
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strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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22. We would not mind our Grade 12 child being a Secretary.
- Teti citusakamike ngacakuti umwana wesu uyu uuli mu
Grade 12 nga aingila incito yabu Sekilitale.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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23. Rural areas are better places to live in.
- Mumishi mwaliwamapo ukwikala ukucila mutauni

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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24. There could be development even without science.
- Ubuyantanshi kuti bwabako nangu takuli ukusambilila
sayansi.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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25. Girls find less difficulties in other subjects than in
science. - Amabwafya abakashana basanga mufisambililo
fimbi tayafula sana ngayo basanga muli sayansi.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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26. If our child was not learning science we could not be
happy.
- Ngacakuti umwana wesu ngatalesambilila sayansi
ngatatwatemwa.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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27. We would rather spend money on buying science books for a child who has the ability to study hard.

- Kuti twatemwapo ukuposa indalama pakushita amabuku yasayansi ayamwana uwakwata umutima wakubombesha mufisambililo ukucila umwana uushakwata umutima wakubombesha.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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28. I would rather encourage a son than a daughter to be a carpenter.

- Kuti nakoseleshapo umwana umwaume ukucila umwana umwanakashi ukuba kalipentala.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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29. Science subjects are hard.

- Ifisambililo fya sayansi fyalikosa.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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30. Physical education just wastes pupils' time to study.

- Ifisambililo fyamangalo ifya Pi-i fiposelafya abana besukulu inshita yakusambiliila.

strongly agree nasuminisha sana	agree nasumina	undecided nshishibe	disagree nakana	strongly disagree nakanisha sana
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to a class than girls.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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8. How well do you expect girls to perform in your subject?

Excellent	V. good	good	average	below average
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9. In my subject I find teaching girls easier than teaching boys.

Strongly Agree	Agree	Disagree	Undecided	Strongly Disagree
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10. Boys seem to be more APPENDIX C in Science than girls are.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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11. Husbands should help wives in their home duties.

MALE OR FEMALE: _____ SCHOOL: _____

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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SUBJECTS YOU TEACH: _____

12. Highly qualified men in the fields of Science are too
PLEASE ANSWER THE QUESTIONS HONESTLY AND FRANKLY. READ
EACH STATEMENT CAREFULLY AND THEN TICK THE ANSWER THAT
BEST DESCRIBES YOUR OWN FEELING ABOUT EACH STATEMENT (TICK
INSIDE THE BOXES).

13. Teaching as a subject to girls boasts as morale to teach.

1. If you do not eat fruits everyday, then your health is
Str. weak. Agree Agree Undecided Disagree Strongly disagree

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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2. Teaching homecraft is a woman's job. Strongly disagree

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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3. Pupils with low ability discourage teachers.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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4. I would rather lend my books to a pupil who has the ability
Str. to study hard. Undecided Disagree Strongly disagree

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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5. People who run away from rural areas should not be forced
to get back.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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6. Most girls cannot have the courage to do Engineering.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

7. Boys could usually be more keen to demonstrate an experiment
to a class than girls. Very active Not very active Not active

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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8. How well do you expect girls to perform in your subject.

Excellent	V. good	good	average	below average
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9. In my subject I find teaching girls easier than teaching
Str. boys. Agree Agree Undecided Disagree Strongly disagree

Strongly Agree	Agree	Disagree	Undecided	Strongly Disagree
----------------	-------	----------	-----------	-------------------

10. Boys seem to be more hardworking in Science than girls are.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

11. Husbands should help wives in their home duties.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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12. Highly qualified women in the fields of Science are too proud to make good wives.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

13. Teaching my subject to girls boosts my morale to teach.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

14. Girls find less difficulties in other subjects than in Science.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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15. A lot of teacher's effort is wasted on teaching science to pupils that are not going to use it in future.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

16. Physical Education makes people think better.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

17. A lady would find doing Mechanics a bit uncomfortable.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

18. Passengers would not have as much confidence in a woman pilot as they would have in a pilot who is a man.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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19. If you teach at a girls' school or co-educational school how active would you say girls are in your class.

Very active	Active	Fairly active	Not very active	Not active
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20. Saddam Hussein is a great man.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

21. If you teach at a co-educational school would you say the best pupil in your subject is a boy?

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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22. Scientists lead a boring life.

APPENDIX D

SCIENCE 5124/2 TEST

TIME: 2 HOURS

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
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23. How much ability to do well in science examination do you think girls have as compared to boys.

Much more	More	Equal	Less	Much less
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24. Women's rights will lead no where

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

25. I would encourage boys more than I would encourage girls to be Engineers.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

26. Ideas and concepts learnt in science do not help most girls in their future careers.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

27. Given the opportunity girls could compete equally with boys in my subject.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

29. Boys are not easily motivated in my subject.

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

30. I really enjoy teaching intelligent pupils

Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

- D. Tripple bond
- E. Weak bond

5. Which one of the following substances reacts with dilute hydrochloric acid to give hydrogen?

- A. Calcium carbonate
- B. Copper
- C. Magnesium
- D. Sodium hydroxide
- E. Zinc oxide

APPENDIX D

SCIENCE 5124/2 TEST

TIME: 2 HOURS

SECTION a

ANSWER ALL QUESTIONS

1. Which one of the following compounds is a base?
 - A. Copper (II) Sulphate
 - B. Potassium
 - C. Magnesium Oxide
 - D. Sodium Chloride
 - E. Sulphur Dioxide

2. The relative atomic mass of chlorine is 35.5 the mass of 2 moles of chlorine gas is:-
 - A. 142g
 - B. 71g
 - C. 35.5g
 - D. 18.75g
 - E. 2g

3. Which one of the following turns moist blue litmus paper red?
 - A. Bicarbonate of soda
 - B. Milk of magnesia
 - C. Sugar
 - D. Table salt
 - E. Vinegar

4. The bonding in hydrogen chloride is
 - A. Electrovalent
 - B. Covalent
 - C. Double bond
 - D. Tripple bond
 - E. Weak bond

5. Which one of the following substances reacts with dilute hydrochloric acid to give hydrogen?
 - A. Calcium carbonate
 - B. Copper
 - C. Magnesium
 - D. Sodium hydroxide
 - E. Zinc oxide

SECTION C

ANSWER ONE QUESTION

10. Write balanced equations, showing states and conditions for the reactions between:

SECTION B:
1B.

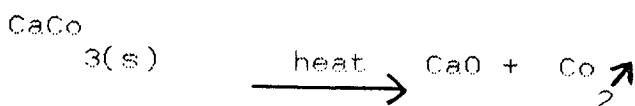
ANSWER ALL QUESTIONS

Element	Electron arrangement
X	2:8:1
Y	2:8:7
Z	2:4

The table shows the electron arrangements of elements X, Y and Z

- (a) What is the atomic number of element X?
- (b) What is the valency of element X?
- (c) What is the atomic number of Y?
- (d) What is the valency of element Y?
- (e) What is the atomic number of Z?
- (f) What is the valency of element Z?
- (g) (i) Draw the electron arrangement when element X reacts with element Y to form a compound.
(ii) Write down the formula of the compound.
(iii) What type of bonding forms this compound? Give a reason for your answer.

2B When calcium carbonate is heated it decomposes as shown in the equation below;



- i) Calculate the mass of calcium carbonate which must be heated to obtain 42g of calcium oxide. Ca=40, C=12, O=16
- ii) What volume of carbon dioxide at room temperature and pressure is produced from this mass of calcium carbonate? (Molar volume of a gas at r.t.p = 24dm³)
- iii) Would you expect sodium carbonate to undergo the same reaction when heated? Give a reason for your answer.

SECTION C ANSWER ONE QUESTION

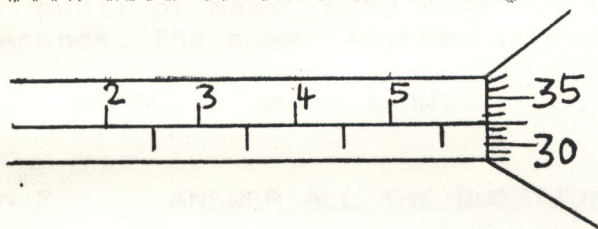
1C. Write balanced equations, showing states and conditions for the reactions between;

- (a) Carbon dioxide and lime water
- (b) Heating mercury nitrate
- (c) Calcium oxide and water
- (d) Heated iron and steam
- (e) Heating lead carbonate
- (f) Calcium and dilute hydrochloric acid

20. (a) Draw a diagram to show the arrangement of apparatus in preparation of hydrogen chloride from concentrated sulphuric acid and common salt.
- (b) Write a balanced equation to show the reaction between the two chemicals in (a)

SECTION D: ANSWER ALL THE QUESTIONS IN THIS SECTION

D1. The diagram below shows a micrometer screw gauge after it has been used to take a reading.



The correct reading is

- A: 5.33mm B: 5.50mm C: 5.53mm D: 5.83 E: 5.80mm

D2. A pupil carried out an experiment with a beaker and some liquid and obtained the following results:-

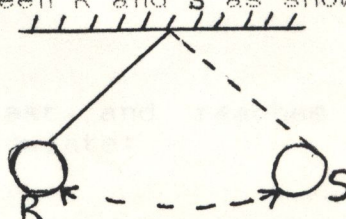
Mass of beaker 88g

Mass of beaker containing 100cm³ of liquid 184g.

From the results it can be calculated that the density of the liquid is.....

- A: 0.88g/cm³ B: 0.96g/cm³ C: 0.84g/cm³
 D: 1.84g/cm³ E: 2.68g/cm³

D3 A simple pendulum swings between R and S as shown in the diagram below:-



What is the period of the motion?

- A. The time to go from R to S and back to R again
 - B. Twice the time to go from R to S and back to R again.
 - C. Half the time to go from R to S
 - D. The number of times to go from R to S in one second
 - E. The time to go from R to S
- D4 What are the energy changes in hydroelectric power production?
- A. electrical _____ potential _____ kinetic
 - B. potential _____ electric _____ kinetic
 - C. potential _____ kinetic _____ electrical
 - D. kinetic _____ potential _____ electrical
 - E. kinetic _____ electrical _____ potential
- D5 A pupil of mass 60kg runs up stairs of height 4m in 3 seconds. The power exerted in raising himself is.....
- A. 7200W. B. 450W. C. 2400W E. 800W

SECTION E Draw ANSWER ALL THE QUESTIONS

- E1. (a) Define power
- (b) A boy exerts a constant horizontal force of 30N when pushing a wheel barrow over level ground and finds that in a time of 60s he has pushed the barrow 100m.
- (i) How much work does the boy do on the barrow?
 - (ii) At what power does the boy operate?
- E2 (a) Define density?
- (b) A block of a certain material is 8.0cm long, 4.0cm wide and 5.0cm high. Its mass is 480g.
- (i) What is the volume of the block?
 - (ii) What is the density of the material from which the block is made?
- E3. (a) Define speed
- (b) A car starts from rest and reaches a speed of 20m/s in 5 seconds. Calculate:

- (i) the acceleration of the car,
- (ii) the average speed of the car,
- (iii) the distance travelled by the car.

SECTION F.

ANSWER ONE QUESTION FROM THIS SECTION

- F1. (a) Explain the difference between vector and scalar quantities. Give two examples of each.
- (b) What is the direction of the frictional force on a person's shoe when starting to walk forward. Explain your answer.
- (c) A mass of 50kg is raised to a height of 10m above the ground level.
- (i) Calculate the work done. If the same mass is now allowed to fall freely back to the ground level calculate:
 - (ii) its kinetic energy
 - (iii) the time taken
 - (iv) in what form(s) of energy is the kinetic energy converted to an impact?
- (d) State the principle of conservation of energy
- F2. (a) Draw labelled diagrams of the experiments you would carry out to show that:
- (i) copper is a better conductor of heat than iron,
 - (ii) Water is a bad conductor of heat. In each case give a brief statement to show how the measurements of observations would demonstrate the desired result.
- (b) Would it be possible to use a mercury in glass thermometer to measure temperature of
- (i) -200°C , (ii) 500°C
- Give reasons for your answers
- (c) What are the temperatures -200°C and 500°C when measured in kelvins (K)?
- (d) A metal plate has a hole drilled through it. When the plate is heated will the diameter of the hole increase or decrease? Explain your answer.

E N D: