Comparison of Females and Males in School Achievement

Enrollment Patterns and School Attitude

In Zambian Schools

By

Clement M. M. Siamatowe ©

THE UNIVERSITY OF ALBERTA

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Dedication

I dedicate this thesis to my children Mizinga, Kantu and Mweemba.

Abstract

The purpose of this study was to investigate gender differences in Academic Achievement, School Attitude, and Enrollment Patterns in Zambian schools. Using 2x2 ANOVAs, Grade 7 (N=100) and Grade 9 (N=100) scores were analyzed. The independent variables were gender and locality; dependent variables were scores in English language, mathematics and science subjects. At Grade 12, the entire student population (N=14216) was included in the descriptive analysis. ANOVA results show that there were no significant gender differences in English language at both Grade 7 and 9. Grade 12 English results show that females outperformed males by a very small margin. Significant gender differences in favour of males occurred in mathematics at both Grade 7 and 9. Males had much better performance in mathematics at Grade 12 also. Significant gender differences were present in science at both Grade 7 and 9 and were both in favour of males. At Grade 12, males outperformed females in physics, chemistry, and biology. Locality was significant for English at Grade 7 but was not significant at Grade 9. Urban students had better scores than rural students. In mathematics, interaction effects were significant for both Grade 7 and 9 but locality was non significant at both levels. Rural females performed more poorly than urban males. Males had better scores than females regardless of locality. Science results show that locality was significant for Grade 7 but not Grade 9. Urban students performed better than rural students. School Attitude Scores for females were below those for males in all the scales of School Attitude Measure. Similarly, attitude scores for rural students were below those for urban students in all scales of SAM. Enrollment Patterns show that females had a higher dropout rate than males through out the school system. Enrollments patterns show that males dominated science subjects at higher levels of the school system.

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CHAPTER I

INTRODUCTION

Background to the study

The problem of gender inequality in the socioeconomic fields has been of major concern to the Zambian government for a long time. In education, females have been at a disadvantage both in terms of numbers enrolled in schools and also in performance levels (Kelly, 1991). In 1964, the percentage of female university graduates was only four percent. Male students greatly outnumbered female students at primary, secondary and tertiary levels.

The main cause of gender differences in enrollment is to be found in the social and cultural practices of the Zambian people. Zambians have different educational objectives for the two genders e.g. Kelly (1991) noted that Zambian teachers appeared to emphasize literacy and skills necessary for the local economy for males. In the case of females, the principal objective was the acquisition of skills and knowledge for domestic use.

After 1964, Zambia's education system expanded rapidly. However, the resources were not sufficient to allow every eligible student to be in school. Emphasis was placed on the nationwide Grades 7 and 9 examinations, which were used to select the best students to fill the limited spaces available in schools.

After Zambia attained national independence in 1964, the Zambian government realized that female students were not performing at the same level as male students in all examinations, therefore lower cut-off points were introduced in order to ensure that females went to secondary school and beyond in sufficient numbers (Kelly, 1991). This procedure did not however address the problem of why female performance was poorer than that of males.

Poor performance in science and mathematics was evident in all Ministry of Education reports although no effort was made to solve this problem. The first major study on gender differences was by Kelly (1991). Kelly noted that females have consistently performed much poorer than males in every subject and at every level of education. The report by Kelly suggested that poor performance by females was primarily the result of poor school attitudes by all sections of society including parents, teachers, peers, and others.

The Zambian government recognized the direct relevance of mathematics and science in the country's economic development as highlighted in its report of 1977. The report called for increased attention to the teaching of mathematics and science. More funding was made available for this purpose. More training was provided to teachers and more books were written for the teaching of mathematics and science with the help of the government (Ministry of Education Report, 1977; Kelly, 1991)

Researchers on gender differences have been especially concerned because differences have occurred in science and mathematics, subjects which were considered by many as important filters that have prevented many women from advancing both in education and in jobs that require advanced knowledge of these subjects (Maccoby & Jacklin, 1974).

The importance of mathematics was emphasized by Robitaille (1990) who noted that this subject is so important that in most countries, between 12 and 15% of class time is devoted to its study. Robitaille also observed that mathematics is often seen as contributing to the overall intellectual development of students, as preparing them to function as well informed citizens in contemporary society, and providing students with the background and skills in the fields of Commerce, Industry, Technology and Science.

The influence of the socioeconomic status to which a student belongs on academic performance has been well documented (Rosier & Long, 1991). In Zambia, the rural-urban income disparities have been substantial for a considerable period, e.g. in 1976, the richest 5% of the households had roughly 35% of the entire national household income (ILO.JASPA 1981, cited in Kelly, 1991). The majority of these households were in urban areas. The majority of the working class families who earn regular incomes and most of whom have a good education, are found in urban areas.

Some researchers (e.g., Mwamwenda, 1989) have argued that the environments found in rural and urban areas are very different and that these differences affect cognitive ability. Mwamwenda observed that the urban areas are more challenging than the rural areas and as a result the students found in urban areas are cognitively superior.

One of the many factors identified that are different for urban and rural areas is the home environment. Studies done in the United States by Garber and Ware (cited in Winzer & Grigg, 1992) show there is a correlation of 0.43 between the quality of home environment and the IQ of a child. They found that the important home factors were: the number of books and other learning materials in the home, the amount of reward and recognition received from parents for academic achievement, and the parent's expectations regarding their children's academic achievement.

The home environment in rural Zambia is very different from that found in an urban home. The home environment in rural Zambia is culturally not conducive to pursuance of formal education partly because of the multiplicity of domestic chores to be done after school, especially by females. There is also lack of learning materials because people cannot afford them.

Additional advantages in the case of urban students include larger space for studying, availability of more and better quality of food, relatively shorter distances between home and school, better qualified and experienced teachers and availability of more educational resources such as books in libraries and educational radio and television programs.

Studies done by several researchers (e.g. Fish, et. al., Willerman & Fieldler, 1974; cited in Winzer & Grigg, 1992) show that there is a correlation between parents social and educational backgrounds. In fact the parents' social and educational background was found to be the best correlate with IQ scores among children. Parents found in urban areas, especially in Zambia, have superior social and educational background in comparison to rural parents. Most parents in rural Zambia are barely literate and are self employed but the majority of urban parents are literate and are employed by government agencies or companies.

Previous studies of parents with superior education indicate that they tend to pressure their children of both genders not only to reach higher levels of education but also to get better results. This is not necessarily true of parents who have no more than primary education (Ndondo, 1984; cited in Kelly, 1991).

PURPOSE OF THE STUDY.

The main focus of this study was to compare Zambian female and male students in academic achievement, school attitude and enrollment patterns. The school subjects of interest were English Language, Science and mathematics at Grades 7, 9 and 12. Comparisons were also made between rural and urban students in order to assess the impact of the differences found in the two environments.

In order to assess gender differences in academic achievement, past scores in the relevant subjects were obtained from the Ministry of Education for analysis. The school attitude was assessed by administering the School Attitude Measure (SAM). Enrollment patterns were derived from analyzing grade and subject enrollments information provided by the Zambian Ministry of Education.

SIGNIFICANCE OF THE STUDY

There is a need to study gender differences in Zambia because little research has been done in Zambia on this topic and females have continued to perform very poorly at all levels of the school system. Research focused on the differences in academic achievement between rural and urban students have been virtually ignored. This study will provide useful information to both the Zambian government and to cross cultural researchers.

The two main questions addressed in this study were:

1. Do gender differences in achievement, school attitude, and enrollment patterns exist in Zambian schools?
2. Do gender differences among rural students differ from those in found among urban students?

Definition of terms

Since some of the definitions used in this research may be confusing, a number of definitions specific to this study are included. Achievement and ability are not easy terms to distinguish. Both are based on past achievement. Achievement can be measured directly, but ability is inferred from achievement and cannot be measured directly. Both general ability and past achievement have been found to be good predictors of future achievement (Aiken, 1971). For this study however, the word achievement is preferable to the word ability since the former can be directly measured.

Quantitative ability versus mathematics achievement.

Most of the literature reviewed does not clearly distinguish between the two as mathematics examination results are often referred to as assessments of quantitative ability (e.g. Maccoby & Jacklin, 1974). In this study mathematics achievement is the preferred term since school based examination results were being studied.

Verbal Ability versus Achievement in Language.

No clear distinction between verbal ability and achievement in language is made in the literature reviewed. In this study , the words achievement in language are preferable to verbal ability.

Gender

This study has obvious implications for a discussion on gender differences. For such a discussion, the term gender is used with reference to one's prescribed status based on behaviors not only related to reproduction, but which are, nevertheless, evaluated within a given society as being more appropriate for members of one sex than the other (Wittig, 1979). However, for the purpose of classification of subjects for the current study, the researcher simply took note of the category "male" or "female" on the examination booklet.

Overview of Thesis

The relevant literature is reviewed in Chapter 2. Chapter 2 includes issues related to gender differences in achievement in a number of selected subjects at various levels of education and in different countries. The relationship among school attitude, academic achievement and enrollment patterns are also discussed. The methods used, research design, selection of subjects, instruments used, data collection procedures, data analysis, limitations and delimitations of the study are included in Chapter 3. The results are described in Chapter 4, and the summary, conclusions and the recommendations are included in Chapter 5.

CHAPTER II

REVIEW OF LITERATURE

Introduction

In the following review of literature, the history of the research related to gender differences is presented. Later, there is a focus on gender differences in academic achievement in languages (mostly English), mathematics, science, and in spatial ability and how these differences might be caused. Conditions that may affect cognitive ability, such as locality (urban, rural), school attitude, and enrollment patterns are also presented.

Interest in the study of gender differences, especially in North America, is mainly attributed to the increased activities of the women's movement in the 1960s (Sells, cited in Linn & Petersen, 1986). It was also during this time that Maccoby and Jacklin (1966) published a very influential book containing a review of literature on gender differences covering 1400 studies. Maccoby and Jacklin found no gender differences in general intelligence. They however found gender differences in mathematics and English language and visual-spatial ability. The mean scores for males were found to be higher than those for females in mathematics and visual-spatial ability. On the other hand, gender differences in the test scores for English were in favor of females. Similar observations were also noted by Messick (1972) and Halpern (1986).

Hyde and Linn (1986), used a meta-analytic approach to analyze 16 of the 1400 studies covered by Maccoby and Jacklin. The 16 studies had subjects that were twelve years and older. They found that gender differences existed in the same disciplines mentioned by Maccoby and Jacklin in this age group. Hyde and Linn found the largest gender differences to be in spatial ability, followed by mathematics. The variances of the gender differences in English language were found to be the smallest. The variances of the gender differences in spatial ability were reported as being four times as large as those found in mathematics. However, since the means and the standard deviations were not reported, it is difficult to ascertain exactly what the author means by the statement.

Because of the smallness of the gender differences in language, Lips and Colwill (1978) disputed the presence of gender differences mentioned in Maccoby and Jacklin's book. Klein (1985) however noted that the small differences become important when top achievers are considered, especially for such purposes as college admissions. He noted that there are twice as many male high achievers in mathematics and science as there are females. There are also many more female low achievers than males in the same subjects.

Research findings on gender differences have not been easy to compare and interpret because researchers have often measured different aspects of the same concept and have also used different methods to collect and analyze their data. Maccoby and Jacklin (1974) used a narrative method in which they simply summarized those studies that showed significant differences and those that did not. The method used by Maccoby and Jacklin was criticized by some researchers (e.g. Block, cited in Wittig, 1979; Hunter, Stemmed & Jackson, 1982). Hunter and his colleagues, pointed out that this method was misleading since it was non quantitative, unsystematic, subjective, and too difficult for any person to process. Maccoby and Jacklin's studies nevertheless formed a basis for many subsequent studies. The importance of the conclusions of their pioneering research is evidenced by the many references being made to their research by almost all current writers on this topic.

A number of methodological problems encountered by researchers in gender difference studies were highlighted by Petersen & Wittig (1979). These include the following: dependency on published studies which may have errors; unreliable instruments; inappropriate sample selection; lack of singular definition of constructs; need for reliable and valid measures of constructs; the tendency to look for differences rather than similarities, and for quantitative rather than qualitative differences.

Among the methods used in gender research are the following:

1. The Traditional Narrative Procedure. The researcher here takes each study at face value to find an overarching theory that reconciles the findings. Petersen and Wittig noted that using this method, studies will almost never be precisely comparable in design, measure and in other areas. There is also danger in oversimplification.

2. The Traditional Voting Method. In its simplest form, it consists of tabulation of significant and non significant findings. The number of studies falling into each of these categories is simply tallied. If a plurality of studies falls into any of these categories, with fewer into the other, the model category is voted the winner. Eagly (cited in Hunter et. al., 1982) noted that the Voting Method is biased in favor of large scale studies that may show only small effect sizes.
3. Cumulation of P-Values across Studies: This procedure attempts to cumulate significance levels across studies to produce an over all p-value (significance level) for the set of studies as a whole. Hunter and his colleagues noted that the main problem with this method is that in most sets of studies, the combined p-value will be significant, but the fact tells nothing about the magnitude of the effect. A combination of p-value and effect size has been advocated by Rosenthal and Rubin (cited in Hunter et. al., 1982).
4. Statistically Correct Vote-Counting Methods. There are two categories. The first category includes all the methods that yield a statistical significance level for the body of studies. The second category includes all the methods that provide a quantitative estimate of the mean effect size.
5. Meta-Analysis of Research Studies. This is a quantitative cumulation and analysis of descriptive statistics across studies.

It does not require access to original study data (cited in Hunter et. al., 1982).

Although some statistical methods may adequately meet the deficiencies in methodology pointed out by Petersen and Wittig (1979), they still do not answer the question of practical importance, which is judgmental. The question of practical importance is worth noting because gender differences in a number of areas may have very little impact on a person's general ability. In spite of these different methods, there has been some areas of general agreement on issues of cognitive ability and gender which are discussed in the following paragraphs.

Gender differences in academic achievement in selected subjects

Achievement in Language skills.

Achievement in language skills has been measured in a variety of ways, and, as a result, different aspects of speech and written language have been used to assess children's performance levels. In the past, researchers have assessed language usage, word fluency, grammar, spelling, reading, verbal analogies, vocabulary, oral comprehension, speech production, essay writing and anagrams (Halpern, 1986; Hyde & Linn, 1988; Maccoby & Jacklin 1964, 1974).

Maccoby and Jacklin (1966, 1974) noted that males outperformed females in vocabulary and semantic processes in most of the studies they included in their review of literature. Females demonstrated superior performance in the rate for basic language and reading processing. A meta-analytic study by Linn and Petersen (1986) also confirmed female' superiority in both spoken and written language. A recent study in Saskatchewan by Randawa (1991) observed a consistent female advantage in verbal tests and skills throughout the school years. Halpern (1986) also noted that some universities have had to use a higher SAT-verbal score cut-off for females because of the high scores obtained by them in comparison to males.

Further evidence of female superior performance in languages was reported by Stobart, Elwood and Quinlan (1992) when they analyzed the British advanced level examinations for all examination candidates for the period 1987-1990. In English language, the total male student entry was 842,969 compared to the female entry of 906, 610. The mean difference in favor of females in English was 13.1 %. About 56.6% of the females gained top grades A to C in English compared to only 41.5% for Males. The mean differences in scores in favor of females in English literature and French were 12.5 and 5.6% respectively. The female students therefore demonstrated overall superior ability in all languages which are tested.

A study by Kelly (1991) involving over a million subjects in Zambia for the period 1977 to 1985 shows that males outperformed females in English language at Grades 7, 9, and 12. Females have however outperformed males in Grade 12 English literature for the past 7 years.

Age and Achievement in Languages

An interesting observation is that gender differences in language seem to be a function of age (Halpern, 1986; Hyde, 1981; Waber, 1979). Female superiority in language functioning appears with the onset of language, is present through out childhood and appears to level off somewhat after adolescence when males tend to close the gap. Waber also pointed out that the developmental pattern of such linguistic functions parallels the developmental pattern of neuromotor functions. Jacklin (1979) argued that because girls tend to mature earlier than boys, the cortical areas of the brain responsible for language development tend to function earlier in females. Randawa (1991) noted that female students in Saskatchewan demonstrated an advantage in language ability from Grade 4 onwards. This female advantage widened, beginning at junior high school level. The consensus among researchers seems to be that gender differences are small or non existent when children are young and still in primary school. Differences begin to show after primary school and there after increase rapidly (Jacklin, 1989).

Heritability of Language ability

Researchers are divided over the issue of whether the observed gender differences in language ability are mostly inherited or influenced by the environment. Some researchers (e.g. Waber, 1979; Jacklin, 1989) think that because female superiority in language ability is demonstrated at a very young age and is so widespread, there might be some ground for believing that there is a genetic component to language ability which later leads to gender differences in academic achievement. Another piece of evidence used by those who advocate for this view is the observed vulnerability shown by males. Many studies (e.g. Halpern, 1986; Hyde, 1981) reported that after a head injury affecting the ability to speak, female recovery of the language function is higher and much more successful. The explanation given for this resilience shown by females is the greater lateralization of the female brain in comparison to the male brain. With lateralization, one part of the brain could effectively take over language functions from the damaged part (Maccoby & Jacklin, 1974). There is no mention of the extent of brain damage in all these studies.

The size of the language differences between genders reported in the literature has been very small (Halpern, 1986). The small size of these differences are the cause of some doubt with regard to their actual significance. There are some who argue that gender differences in language ability are due to differences in early experiences between males and females. Mothers tend to socialize and speak more to the female babies than they do to male babies (Maccoby & Jacklin, 1974). Newcombe, Bandura and Taylor (1983) argue that whatever differences appear between males and females are a result of environmental influences.

Achievement in mathematics

Gender differences in mathematics achievement have been investigated more than any other area of achievement (Randawa, 1991). Mathematics achievement has been traditionally measured using general performance levels on whole tests. Recently however, the trend has changed. Researchers have begun to look at achievement in particular areas of mathematics tests. Measurement of mathematics at elementary level is sometimes done using subcategories of Computing and Problem-solving. A third category of Geometry is sometimes added. The supposition is that Geometry, has spatial qualities which might be more problematic for females than males (Linn & Petersen, 1986).

Several major studies done on gender differences have produced different results. Maccoby and Jacklin (1974) concluded that gender differences in mathematics exist in North America in certain age groups. This is supported by a meta-analytic study by Halpern (1986) in which moderate gender differences in favor of males in mathematics achievement for students 12 years and older were found.

The picture was somewhat more complex when the tests were analyzed according to specific skills. Females were found to have superior skills when dealing with computational problems. On the other hand, males outperformed females in problem-solving skills and geometry (Halpern, 1986; Hyde, 1981). In Saskatchewan, Randawa (1991) found that from 1978 to 1985, Grade 12 males outperformed females in problem solving and geometry; females however outperformed males in computation. No differences were observed in lower grades. Similar conclusions to Randawa's were reported in other studies (e.g. Hyde, 1990: Hyde, Fennema & Lamont 1990).

In a major study in the United Kingdom by Stobart, Elwood and Quinlan (1991) involving a combined entry of close to 2 million, they observed that from 1988 to 1990, 34.6% of females received good grades of A-C in mathematics compared to 38.9% of males who received equivalent grades. Males on the average outperformed females by 7.1%.

A Zambian study by Kelly (1991) for the period 1977 to 1985, showed that males outperformed females in mathematics at all levels of the school system including university. At Grade 7, the mean difference in mathematics scores in favor of males was 4.4, which was second highest after social studies. The total marks for mathematics was 60.

Not every major study has demonstrated male superiority in mathematics achievement. In a study of student well-being and high school achievement in Newfoundland, Bullock, Whitt and Beebe (1991) observed that females out-performed males in virtually all subjects including mathematics but excluding physics. They also observed that for a period of four years prior to the study, gender differences were observed at Grades 4, 6, 8 and 12 and were all in favor of females.

Studies by Robitaille (1990), which covered five countries from Europe, Asia, the USA and four provinces of Canada, for the period 1983 to 1986, showed only small and insignificant gender differences in mathematics in favor of males and these were reportedly declining. Ethington (1990) also reported that the several countries and provinces of Canada, namely; Japan, Flemish Belgium, British Columbia, France, Ontario, USA, New Zealand, and Thailand that she reviewed, showed no substantial gender differences in any of the content areas, and the slight effects shown favored females more than males. She also reported that there was substantial variability between the regions or provinces within these countries. From the literature, it is evident that the presence or absence of gender differences cannot be generalized to all aspects of mathematics and all countries.

Age and Achievement in mathematics.

A number of researchers have observed that gender differences in mathematics are related to age. Gender differences appear at about adolescent age and thereafter increase as students grow into adulthood (e.g., Fennema & Carpenter, 1981; Hyde, 1981; Maccoby & Jacklin, 1974). Age related differences were also found in a province-wide study of gender differences in Saskatchewan, covering the period 1978 to 1985 by Randawa and Hunt (1987). They observed that until about Grade 4, either no gender differences were observed, or if there were any, they were very small and in favor of males. Mixed results were reported for the junior high school grades. At Grade 10 and above, there were consistent and significant gender differences in favor of males, especially in problem solving and geometry. Females however, outperformed males in computations in Grades 7, 10 and 12.

Randawa and Hunt (1987) reported that in comparing effect sizes for 1978 and 1985, females lost ground in mathematics. This is interesting considering that gender differences are reportedly diminishing elsewhere in North America as consistently reported by a number of researchers (Feingold, 1988; Hyde, 1981; Linn & Petersen, 1986; Marsh, 1989).

In Zambia, gender differences in mathematics achievement, although present at all levels of the school system, seemed to increase with age. They were smallest at Grade 7, moderate at Grade 9 and largest at Grade 12 (Kelly, 1991).

Achievement in mathematics and general ability.

Wise (1985) noted but did not explain why females in North America with mathematics participation and ability equal to males had scores that averaged one standard deviation lower than that of males. Chipman and Wilson (1985) also noted that males who enrolled in fewer mathematics courses still performed better than females.

In her studies, Ethington (1990) concluded that with equal mathematics participation and ability, gender differences have been either very small or nonexistent. Wise (1985) also noted that gender accounted for only 1.6 percent of the variation in Grade 12 achievement in the USA when such factors as general intelligence, interest in

Mathematics, and low level of participation are not controlled. When these factors are controlled, only .02 percent of the variation is accounted for by gender.

Causes of gender differences in mathematics achievement.

There are several reasons advanced for the presence of gender differences in mathematics achievement. Erickson and Farkas (1987) pointed out that either females outperform males or no gender differences occur at elementary level because mathematics is mostly serial. Males outperform females at higher grades because mathematics increasingly becomes spatial. Chipman and Thomas (1985) noted that the single most important factor contributing to gender differences in mathematics achievement in high school is the number of mathematics courses taken between Grade 9 and 12. Wise (1985) also noted that the two strongest predictors of Grade 12 test results (i.e. Grade 9 test results and number of mathematics courses taken in Grade 12) had high correlations (r=.78, r=.73) respectively. Other factors that affect mathematics achievement include general aptitude, interest in the subject, and participation in mathematics extra-curricular activities (Wise, 1985). Steel and Wise (cited in Petersen & Wittig, 1979) noted that it is after Grade 9 that females start taking fewer mathematics courses, and it is during this time that the largest gender differences emerge. Kelly (1991) suggests that item bias has been a factor in Zambia in accentuating gender differences in mathematics achievement. He noted that previous studies have shown that examination papers in Zambia were biased in favor of males. It has been shown that items that are mostly based on activities familiar to one gender tend to be easier for that gender to deal with (Maccoby & Jacklin, 1974).

Why females take fewer mathematics courses

There are many reasons given to explain why females enroll in fewer mathematics courses in North America and elsewhere in the world. Mathematics is still regarded as a male domain. Many women are therefore not interested in mathematics-related careers. The few that are interested are likely to take more mathematics courses (Armstrong, 1985). Wise (1985) noted that differences in career interests and interest in mathematics itself were already evident in Grade 9. These interest differences at Grade 9 lead to the observed gender differences in the number of mathematics courses taken during high school years.

There is also evidence that persons significant to students have an important influence on their attitudes towards mathematics. Parental encouragement, parental educational expectations, and counselor encouragement, have been shown to be the best predictors of participation in mathematics (Armstrong, 1985). Parsons (cited in Petersen & Wittig, 1985) and Linn and Petersen (1985) reported that parents had gender-differentiated perceptions of their children's mathematics aptitude despite the similarity of the actual performances of males and females. This attitude by parents tends to perpetuate stereotyping of male and female roles. There is also evidence that some teachers, school counselors and other socializing agents contribute towards reinforcing sex-stereotyping (Fox, Tobin & Brody, 1979; Parsons, Adler & Kaczala, 1982; Parsons, Kaczala & Meece, 1982). These socializing agents have been observed to affect children very early in life (Deaux, 1984).

There are indications that females are starting to take careers in mathematics and science seriously. There has been a decline in gender differences in enrollment in mathematics and science in the USA. This has partly contributed to narrowing the gap in mathematics achievement (Armstrong, 1985).

Recent studies show that females are increasingly feeling confident about their ability to do mathematics and science and to pursue related careers. Robitaille, O'Shea, and Dirks (1982) surveyed students opinions in British Columbia with regard to the usefulness of mathematics and science to females and males. They also asked if females were as capable as males in mathematics and science as students and later on as scientists. The results indicate that both groups felt that males and females are equally capable as students and later on as scientists and mathematicians. Both males and females equally rated the usefulness and importance of mathematics and science.

Achievement in science

The findings with regard to gender differences in science achievement remain inconclusive. Science is unique in that it is related to both quantitative and spatial abilities (Hyde, 1981). This is especially true of subjects like physics where mathematics and spatial abilities are both important (Brush ,1985).

Some research has been done to investigate the effect of the level of understanding of the language of instruction on achievement in science. This type of research has often been targeted mainly at students for whom the language of instruction is not their first language. The International Association for the Evaluation of Educational Achievement (IEA) (1988 Preliminary Report) shows that in some countries where instruction in science was in English but where English is not the first language, sometimes students performed better than students in other countries where English is the first language and also the language of instruction. It seems only a minimal level of English or the language of instruction is necessary for a student to perform well in science (Rosier & Long, 1991).

Mixed Results for science achievement.

The size and presence of gender differences are dependent on a number of factors. Linn and Hyde (1989) reported that the gender gap in achievement is disappearing in North America. This does not seem to be true in every country. Erickson and Farkas (1987) reported that both provincial and international assessment in Canada have shown consistent gender differences in recent years in mathematics and science. Randawa and Hunt (1987) observed that females were in fact losing ground in these subjects, especially at high school level. In Newfoundland (Canada), Bullock and his colleagues reported that gender differences have existed in science in the past four years. The differences in academic achievement were in favour of females except in physics.

In a study by the International Association for the Evaluation of Educational Achievement (IEA), 1988), covering twenty four countries reported that males scored higher than females at all levels in science. The report indicates that the differences widened from the 10 year old to the 14 year old level with standard deviations in scores ranging from 0.23 to 0.34. The differences at Grade 12 were even higher in physics and chemistry where the standard deviations were 0.36 and 0.39 respectively. Without knowing the means for each group, understanding the comparison is difficult. For all the countries under study, gender differences in biology were either non existent or where present, were marginal in size and often in favor of females. The report concluded that from 1970 to 1986, there has been little change in the superiority of male achievement in mathematics and science in comparison to females at the Grade 9 and Grade 12 levels.

In a nationwide study of science achievement of Grade 12 students in Australia, Rosier and Long (1991) found that male students had higher average test scores than female students for all tests except the biology test, in which there was little difference between males and females. They also found that the Socio-Educational Index consistently explained the greatest variation in all tests and remained significant even when the effects of other variables were removed. The gender of the student came out as the next strongest variable for explaining the variation in test scores except for the physics test scores.

A recent study by Stobard, Élwood and Quinlan (1992) shows that males outscored females in chemistry and biology in the United Kingdom from 1988 to 1990. In physics, females outperformed males. It turns out that the females who enrolled in physics were a highly select group contributing only 28% of the total enrollment in the subject. In biology, where the female enrollment was 62%, males outscored females by 7.3%. In chemistry, males outscored females by 3.3% and the female enrollment in the course was 44%.

The general observation from these studies is that there are fewer enrollments in physics and chemistry for both sexes but especially for females. Students who enroll in chemistry and physics tend to be above average in general intelligence. Biology seems to attract average students from both sexes (Rosier & Long, 1991; Tan ,1986).

Sometimes science achievement is analyzed using two categories divided according to skill; information and reasoning. Meta-analytic studies on science achievement of students in the USA showed that males outscored females in information at both ages 13 and 17 (N=2400)(Hyde & Linn 1986). Steinkamp and Marcher (cited in Linn & Hyde, 1986) reported that gender differences in reasoning were small, accounting for only about 1 percent of the variance (N=2400 for both 13 and 17 year olds). There is no mention of what accounted for the other variance in Steinkamp and Marcher's study.

Kelly (1991) noted that in Zambia, males consistently outperformed females in Grade 7 science by an average margin of 3.3 points for the period 1977 to 1985. The maximum score for Grade 7 science was 50. Similarly, males outperformed females at Grades 9 and 12 in all science subjects. Kelly also reported that for the period 1974 to 1985, an average of less than 10 percent of university students graduating with a science degree were females. Kelly also noted that it is the brighter students who usually enrolled in mathematics and science courses in Zambia at both school and university levels.

Causes of Gender Differences in science achievement

The reasons given by various researchers to explain gender differences in science achievement are similar to those given for mathematics earlier in the chapter. Gender differences in science achievement are due to fewer number of science courses taken by females, especially in high school (Chipman, Brush & Wilson, 1985; Erickson & Farkas, 1987). Different course enrollments in sciences for females and males is probably caused by a number of reasons including interest in the subject, career intentions, ability and influences from the significant others (Chipman Brush & Wilson, 1985; Haggerty, 1991).

Chipman, Brush and Wilson also noted that females have different out of school science-related experiences than males. Females are less confident about their ability in science even when females have comparable general ability with males. They also found that high female achievers in science were not necessarily following careers in science.

Poorer performance by females has sometimes been blamed on gender-biased items. Gender-bias in test items often work to the disadvantage of females because test items often require information which favors males due to their greater experience in science-related activities (Dwyer, 1979; Erickson & Farkas, 1987: Klein, 1985, Kelly, 1991). Halpern (1986) also noted that females and males use different strategies in solving problems. Certain strategies allegedly work best for certain styles of questioning.

The total number of courses taken in science in the lower grades also affects performance in the same subject later in high school. Females in general tend to take fewer science courses and their performance would therefore be negatively affected by lower course enrollment later in school (Armstrong, 1985). Enrollment in science or any subject where there is a choice is partly indicative of the interest a student has in the subject. In making a choice, students may also be influenced by other factors such as self-concept, career choices and outside pressure (Klein, 1975). Interest in science has been shown to be related to science achievement (Klein, 1985).

Spatial ability

Spatial ability is understanding the orientation of objects in space, sometimes after motion. Spatial ability is not only of special interest because it is related to mathematics and science achievement but also because it is often used to measure general intelligence.

Different definitions of spatial ability have resulted in different conclusions being made after testing. According to Maccoby and Jacklin (1974), spatial ability can be divided into visual and non visual. Included in the visual-spatial ability category is auditory localization, accurate maintenance of size and distance, constancy, and tactical recognition of objects as they change orientation in space. Linn and Petersen (1986) came up with four kinds of spatial abilities: spatial perception, spatial visualization, task solution, and the ability to discern the relationships of shapes and objects.

Spatial ability tests.

Many types of tests have been used to assess spatial ability. Some show a drawing of a system of gears. Subjects are asked to determine what motion in one part of the system would be produced by a given motion in another part of the system. Some tests include two dimensional representations of three-dimensional piles of blocks. Subjects must estimate accurately the number of surfaces visible from a different perspective than their own. More familiar test would include the Block Design Subtest of the WISC, Mazes, Form Boards, the Embedded Figures Test, and the Rod and Frame Test (Maccoby and Jacklin, 1974).

When the Differential Aptitude Test, the Primary Mental Abilities Test, Mazes, Form Boards, and Block Counting were used to measure gender differences in visual-spatial ability, males performed better than females (Maccoby & Jacklin, 1974). Through meta-analysis, Linn and Petersen (1986) found gender differences in spatial perception and mental rotation but not in spatial visualization.

Age and Spatial ability

There have been some differences among researchers' conclusions as to whether gender differences in spatial ability exist in preadolescent ages. Early researchers such as Maccoby and Jacklin (1966, 1974), reported that no gender differences were apparent in preadolescent years. Other researchers, however, have reported gender differences in younger children. For example, in their meta-analysis, Linn and Petersen (1986) reported the presence of gender differences in 7 year olds.

Heritability of Spatial Ability

Spatial ability is one area where ability has often been linked to hereditary factors (Linn & Hyde, 1989). One of the reasons for this view is the consistency of gender differences in spatial ability, especially in the visual area. Halpern (1986) reported that she had observed persistent gender differences when she used the Embedded Figures Test and the Rod and Frame Test but was unable to offer an explanation for these findings. Males outperformed females in both tests. She also noted that the variance accounted for by gender in spatial ability was four times larger than for either verbal or quantitative ability.

Another observation made by various researchers is that prenatal hormones influence gender differences in spatial ability both directly and indirectly. Prenatal hormones cause differences in lateral developments of female and male brain organizations (Enrhardt 1977; Reinisch, Gandel, & Spiegel, 1979). More brain lateralisation such as is found in females means less spatial ability. Different rates of brain development and maturation for the male and female may also cause differences in spatial abilities (Waber, 1979). Later development such as occurs in males favors development of spatial abilities; early brain development and maturation favors language development but is detrimental to spatial development (Jacklin, 1989).

Some researchers who have argued in support of heritability of spatial abilities have suggested a sex-linked theory (e.g. Bock & Kolakowski, 1973; Bryden, 1979; Defries et al., 1976). They suggested that the main mechanism for transmission of spatial abilities is through the X-chromosome. The sex-linkage explanation has not been accepted by another group of researchers who argue that all gender differences, including those in spatial ability, are a creation of the environment (Newcombe, Bandura, & Taylor ,1983; Linn & Petersen, 1986).

The relationship among spatial ability, mathematics and science achievement.

There have been several studies that have investigated relationships among spatial ability, mathematics, and science achievement (e.g. Fennema & Carpenter, 1981; Linn & Hyde, 1986). The consensus seems to be that no clear relationship among the three has been well established partly because no clear pattern has emerged with regard to age of first appearance (Linn & Petersen, 1986). The overlap of spatial abilities required in mathematics and science are the reason why high correlations have been reported. In correlational studies done by Sherman (cited in Wittig & Petersen, 1979), visual-spatial skill was found to be a significant factor of mathematics achievement. In fact Sherman observed that correlations between visual-spatial skills and mathematics achievement were higher than those for general intelligence and mathematics.

Connor and Serbin (1985) pointed out that logical analysis of the nature of visual-spatial ability and mathematics achievement suggests that they should bear an important relationship to one another since they both depend on a cognitive skill involving the ability to perceive spatial relationships and to manipulate visual material mentally. Fennema and Sherman (1977) noted that mathematical ability is probably a compound of general intelligence, visual imagery, ability to perceive number and space configurations as mental patterns. The same can be said of subjects like physics. Most researchers argue that high correlations should not be interpreted as having meaning beyond this overlap or dependency on cognitive spatial skills (Linn & Pulos, 1982).

Linn and Petersen (1986) suggest that the most reasonable approach to the teaching of science and mathematics would be to assume a model of gender differences in mathematics, science achievement, and spatial ability based on multiple correlations of analytic reasoning, course experience, factual knowledge, interest and confidence. Some have suggested that the most effective response to gender differences in mathematics achievement, and spatial ability is instruction to ensure that most effective strategies are used to achieve the best results (Klein, 1985). This should be possible since learning of spatial tasks has been demonstrated (Cohen, 1979; Connor & Serbin, 1985). Connor and

Serbin also found that visualization may be a more difficult skill to teach than spatial orientation.

Unspecified nature of spatial ability, mathematics, and science achievement.

Part of the difficulty in establishing the hypothesized relationship among the three constructs is that spatial ability, mathematics and science achievement are not well defined or not unidimensional (Connor & Serbin, 1985; Hyde & Linn, 1986). It is suggested that the only way comparable results among studies could be obtained is to have singular definitions of the abilities, achievements and content areas to be measured (Hyde & Linn, 1986). This is neither necessary nor possible because some aspects of spatial ability require different ways of measuring them which are more appropriate.

Locality differences in academic achievement.

Another area of interest is the sizes of gender differences in academic achievement between urban and rural schools. Mwamwenda (1989) investigated how males and females who lived in both urban and rural areas performed when given various Piagetian tasks. He concluded that both males and females in urban areas performed better than their rural counterparts. Mwamwenda also noted that locality as such does not affect intellectual development, it is the totality of human interaction within the physical environment.

One important factor which is likely to affect intellectual development in less wealthy areas, usually rural, is malnutrition (Opper, 1977). Malnutrition does not only affect the physical health of individuals but also affects mental development. From personal experience, this is of major concern in Zambia where malnutrition is more common in rural areas.

There is also evidence that varying stages of industrialization affect intellectual development since urban areas are generally associated with a greater degree of technological advancement than rural communities (Opper, 1977). Mwamwenda (1989) also argues that the urban areas have an enriched, invigorating and unique environment conducive to cognitive development in comparison to rural areas.

In one of the major studies investigating gender and rural-urban differences in academic achievement, Randhawa and Hunt (1987) analyzed scores obtained by students in grades 4, 7 and 12 in Saskatchewan. Significant univariate differences in favor of rural students were obtained in punctuation, capitalization and mathematics concepts subtests. Urban students surpassed rural students on the vocabulary subtest. These tests were given at Grade 4. At Grade 7 significant univariate differences, in favor of urban students, were obtained on comprehension and mathematics problem subtests. The rural students outperformed urban students in spelling and punctuation subtests.

Randhawa and Hunt (1987) concluded that overall, male superiority in mathematics and female superiority in English language were upheld. Randhawa observed that male superiority in mathematics achievement seemed developmental but independent of rural-urban residence.

In another major study, Clarke, Nyberg and Worth (1980), using a Grade 3 province-wide sample in Alberta, found that children from rural areas performed better than those in urban areas in reading, mathematics, and English language.

Enrollment patterns and achievement.

Understanding enrollment patterns is important because they tell us how many students from each gender or group are promoted from one grade to the next. This is especially important where grade places are competitive. Secondly, subject enrollments show the pattern of subject preferences by either gender or group.

Robitaille (1990) observed that females are under represented in science and mathematics enrollment worldwide. In British Columbia, Robittaile noted that females constitute 40% of the population of senior mathematics students. This compares with 44% in the USA, 34% in the United Kingdom, 26% in Sweden, and 22% in Japan and 32% in Zambia.

Course enrollment is the single most important factor in subject achievement (Chipman & Thomas, 1985). Those who enroll in more science and mathematics courses tend to do better than those who enroll in fewer courses. Armstrong (1985) noted that in the United States, course enrollments were roughly even across genders in science and mathematics at elementary school level but males enrollment exceeds female enrollment at junior high level. Because females take fewer mathematics and science courses in school, they also tend to take fewer mathematics and science courses at universities and colleges.

Wise (1985) however noted that even when males take fewer number of related courses, they still perform one standard deviation above females. Ethington (1990), noted that the causes of gender differences are many, e.g. differences in general intelligence, interest and participation. When these factors were controlled, gender differences only accounted for 0.02% of the variation. Rosier and Long (1991) found that the Socio-Economic Status accounted for greater variation than gender.

In deciding which and how many courses to take, both females and males are affected by such factors as socioeconomic status, ability, attitude and interpretation of social milieu concerning appropriateness of their studying mathematics and science (Brush, 1985).

Lack of course preparation is however just one of the factors. Klein (1985) noted that females who enroll in many science and mathematics courses in high school and subsequently do well, do not necessarily pursue careers in science and mathematics. Boswell (1985) noted that only 2% of engineers, 2.5% of doctorates in physics, and 10% of doctorates in mathematics were held by women. Fewer than 10% of the females who have graduated from the University of Zambia hold degrees in science and mathematics and most of these have gone into teaching (Kelly, 1991). Those who go into teaching in Zambia have lower grades than other students in other departments. They also take fewer mathematics and science courses as some of them are replaced by education courses.

Grade enrollment patterns are crucial in understanding gender and group differences. Halpern (1986) noted that more males drop out of school than females in North America. She noted that the males who remain in school tend to be a select group of disproportionately high achievers in comparison to females. To give an example, in the UK, the total female student entry for advanced level examinations for 1988 to 1990 was 906,610 and 842,969 for males. There were 63,641 more females than males.

The situation is somewhat different in Zambia and other developing countries where the reverse is true. The females who remain in school do not necessarily perform better than males. There are also usually more males than females who remain in school. Males also tend to have higher GPA than females.

Enrollment patterns ought to be taken into account in any analysis of school examination results involving gender comparisons since restriction of range may distort results. Restriction of range may be due to the selection process, ceiling or floor effects. Chipman and Thomas (1985) noted that gender differences in course enrollment were largely confined to advanced courses. This is also true for Zambia where only students in the junior and senior secondary programs have a choice of subjects. It is also at this advanced level that careers are planned.

School attitude and academic achievement.

The relationship between some cognitive and affective variables have long been recognized, especially with regard to school achievement. Included in the cognitive category are basic abilities and skills in school subjects. The affective domain includes many variables such as school attitudes, social interests and preferences by both the student and those that work with the student both at school and at home.

Some of the important affective variables that affect subject performance have been briefly discussed in other sections of this Chapter. In a study on attitude towards mathematics, Boswell (1985) identified three major barriers which preclude women from mathematics-related fields: external structural barriers, social pressures, and internal barriers. External structural barriers include overt sex discrimination against women in educational, scientific, and business institutions. Social pressures are from significant others such as parents and peers. Internal barriers have to do with internalized negative attitudes and beliefs about mathematics.

Participation in mathematics and science has been shown to be partly determined by such factors as family background, cognitive abilities, personal aspirations, and the characteristics of the school environment (Wise, 1985). Factors such as the fathers' and or mothers' level of education, social economic status, family size, interest shown by either parent in their children's schooling were all found to affect student academic performance (Haggerty, 1981; Wise, 1985).

Kelly (1991) found that in Zambia, teachers who expected high achievement received stronger commitment and better performance from their pupils. He suggested that the low performance by girls in some subjects in Zambia were due to low expectations by society and teachers.

Armstrong (1985) observed that some women are not interested in mathematics and science related careers regardless of their ability in these subjects. Wise (1985) also noted that such activities as study habits, extracurricular activities and participation in female stereotyped activities also contributed to differences in academic achievement.

Another factor is that females are less confident about their ability in mathematics and science regardless of previous performance in these subjects (Chipman, Brush & Wilson, 1985; Haggerty, 1991). Armstrong (1985) also noted that even with equal ability, parents have different perceptions of their children's' mathematics and aptitude.

Summary

It appears that gender differences still exist in such courses as languages, mathematics and science in several countries including Zambia. Gender differences in mathematics and science haare reportedly brought about by similar causes. Gender differences have also been reported to have disappeared in several but not all the countries. Gender differences in spatial ability have also been shown to exist especially from age 12 years and above. Enrollment patterns, school attitude, and locality, are reported to influnce achievement.

CHAPTER III

METHOD

Overview of Chapter

This study was designed to investigate gender and locality differences in academic achievement, school attitude, and enrollment patterns in Zambian schools. Presented below are the questions which were investigated, the research method, the research design, the selection of subjects, the instrumentation, the data collection and the recording, data processing and analysis, and the limitations and delimitations of the study.

Research Questions

The following research questions were investigated:

1. Do gender differences exist in Grade 7 in English, mathematics and science achievement scores and in selected skills within these subjects?
2. Do gender differences exist in Grade 9 in English, mathematics and science achievement scores?
3. Do gender differences exist in Grade 12 in English, mathematics, physics, biology and chemistry achievement scores?
4. Are the gender differences in achievement scores for rural and urban areas different for Grade 7 and 9?

5. Do gender and locality differences exist in attitude scores?
6. Do gender differences exist in enrollment patterns?

Description of Method

The first part of the study involved obtaining past achievement raw scores or scripts and keys, if still available, for English language, mathematics and science for Grades 7, 9, and 12 from the Zambian Ministry of Education. Secondly, the School Attitude Measure was administered to the Grade 7 sample to obtain attitude scores. Information on both grade and subject enrollments was obtained also from the Ministry of Education records.

All students in the Zambian school system are given identification numbers for the period they remain in the school system. This same number is also used for examination purposes. Only examination numbers are inserted on examination scripts to ensure anonymity of the candidates. Scripts collected for the study were identified by student number only.

Other available data on each student include, gender, school name, year of examination, date of birth, and subject raw score. From the school name it was possible to categorize students as rural or urban depending on the location of the school.

Students in Zambia go to school for seven years, after which they sit for an external nationwide examination. Those who proceed to junior high school have to sit for the Grade 9 examination in order to get promotion to Grade 10. The Grade 12 examination takes place after 12 years of study. The results for these examinations were used in this analysis.

Grade 7 achievement scores

English Language, mathematics and science test scores for the sample were obtained from the scripts. The test items for each examination were later categorized to match selected skills prior to marking. English language was divided into three categories: (a) Usage (b) Word and Sentence Meaning, (c) Comprehension, Writing and Reading skills. Mathematics was divided into: (a) arithmetic, (b) geometry and (c) algebra. The science test was divided into (a) information and (b) reasoning and application items. Marks were obtained from the examination scripts where available. The marks for the whole paper as well as for individual sections were recorded separately.

Grade 9 achievement scores

The raw scores for English language, mathematics and science were obtained from the mark sheets provided by the Ministry of Education. The original scripts were not available in this case. Both the total scores for the entire paper as well as section totals were shown on the mark sheets.

Grade 12 Achievement scores.

The only available information at this level were summary statistics which show how many students passed in each category. At Grade 12, the results were presented according to the following grading system: distinction (1,2), merit (3,4), credit (5,6), pass (7,8) and fail (9). From this summary, records were extracted for all students who obtained distinction, merit, credit, pass and fail. The records for English language, mathematics, advanced mathematics, physics, chemistry and biology were obtained. Unfortunately, there was no separation of urban from rural students, everybody was included in the national figures. Students were however identified by gender.

Research Design

Grades 7 and 9 scores were analyzed using 2 x 2 ANOVAS (N=100 for each grade). Independent variables were: gender (F= female, M= male), and locality (U= urban, R= rural). The dependent variables were English language, mathematics and science scores. Descriptive statistics were used to analyze Grade 12 results for all candidates present (N=14216).

The second part of the study involved administering the School Attitude Measure (SAM) to the 1992 Grade 7 sample. The SAM scores were analyzed by scale. SAM scores were also correlated with the achievement scores for each subject. SAM is fully described under instruments. There was no pretest or instruction given to prepare students for this survey apart from the instructions pertaining to taking the test itself.

Details of how many students were enrolled in each grade and in the selected subjects were copied from the records kept by the Zambian ministry of Education. From the data collected, tables, figures, and graphs were made to illustrate the nature of enrollment patterns.

Selection of Sample

Zambia has eight provinces mostly divided according to linguistic groups. Four of these provinces are rural in character while the other four have the majority of their populations living in urban centers. One school was selected randomly from each province. From each school classes to be included in the sample were randomly selected. The samples for Grades 7 and 9 in each case were composed of the following: 25 male-urban, 25 male-rural, 25 female-urban, 25 female rural. The entire Grade 12 student population was included in study.

The sample used for Grade 7 and Grade 9 was for 1992. The data used for Grade 12 was for 1989. Selection of the years included in this study depended on the availability of data.

The Grade 7 sample was composed of males and females who were 12 to 14 years old. Less than one percent of Grade 7 students were repeaters. The students included in the Grade 9 sample were between 14 and 16 years old. The percentage of repeaters in Grade 9 was also less than one percent. The average age for Grade 12 students was 19 years. The percentage of repeaters in Grade 12 was similarly small and was estimated at less than one percent for both genders. Repetition was therefore not considered a major threat to the validity of the studies.

Instruments

The instruments used for this study include Grade 7 and 9 achievement tests for English, mathematics and science, and the School Attitude Measure (SAM). All of the instruments used to measure achievement lacked information on reliability and validity except for the SAM measure. These had to be worked out or described in each case. Under each test, the reliability and validity of each instrument is presented .

Reliability and validity of Instruments

Test scores are in most cases used for drawing inferences about the examinee behavior beyond the testing situation (Crocker & Algina, 1986). Researchers are expected to justify such inferences. Justification has two major components; validity and reliability. A high reliability coefficient usually indicates that there is consistency in examinee scores. Validation is the process of collecting evidence to support the type of inferences that are drawn from the test scores.

There are three major types of validation; content, criterion and construct validation. Where inferences are to be made from test scores to a real behavior variable of practical importance, criterion validation is used. Content validation is used when inferences are to be made from test scores to a large domain of similar items. In cases where criterion and content validation cannot be used, construct validation is preferred. Construct validation occurs where inferences are to be made from test scores to performances that cannot be grouped under a particular construct (Crocker & Algina, 1986).

In this study content validation was used since the goal was to make inferences from the test scores to a larger domain of similar items. In addition the contents of the tests were very clearly defined.
A number of steps for content validation were recommended by Crocker and Algina (1986). These include; defining the domain of interest, identification of evaluation experts, establishing a process of matching items to the performance domain, and collecting and summarizing data from the matching process.

It is the responsibility of the Zambian Ministry of Education to define the domain of interest. The curriculum and teaching objectives are made jointly by the inspectors and curriculum specialists of the Ministry of Education. The participation in curriculum development is broad based and involves several groups such as churches, political parties, universities and lay persons.

The Psychological Service of the Ministry of Education develops test specifications in consultation with other professional departments of the Ministry of Education. The development of test specifications involves formation of various subject committees which see to it that items are representative of the kind of questions they want asked from the curriculum. Various examination committees set examination questions based on the item specifications. The questions are then examined to establish if they are not only appropriate for the grade they are designed for but also for compliance with the item specification guidelines.

The major part of the content validation process was already done by the Ministry of Education. The researcher has sat on many of these committees. In the following paragraphs, a number of relevant characteristics important to the content validation process are described. These characteristics include subject matter, cognitive processes or level of complexity of performance required, stimulus (question) format or mode of presentation, and mode of response required.

There are a number of ways to measure reliability and the coefficients are known by different names e.g. coefficients of internal consistency, equivalence, internal consistency and equivalence and the coefficient of reliability of a composite. A composite is a total score based on two or more subtest scores. The reliability of a composite is expressed in two ways; Spearman Brown Prophecy which is suitable for parallel tests, and Cronbach alpha. Cronbach alpha allows for the estimation of the reliability of a composite when the composite score variance and the covariances amongst its components are known.

All the tests at Grades 7 and 9 were treated as composites. The Grade 7 items were dichotomously scored and had varying degrees of difficulty. According to Crocker and Algina (1986), the most appropriate reliability measure here is Kuder Richardson 20 (KR 20). Grade 9 tests were of a mixed type with each section having a different weighting. Crocker and Algina recommend using Cronbach alpha for this type of test.

Since there were no raw scores and no examination papers obtained, it was not possible to establish either the content validity or the reliability for Grade 12. The School Attitude Measure (SAM) is a commercially produced survey published by American Tetronics. The development of the School Attitude Measure was based on the belief that the affective consequences of schooling are important. Student school experiences contribute to student attitudes about themselves and their potential to succeed in academic subjects.

The development of SAM was based upon prior research and developments in the areas of test design and construction, item selection and calibration, personality and attitude measurement, and the affective correlates of schooling. The nature of the information provided by this measure provides a school an opportunity to incorporate the affective outcomes in decisions regarding the development of standards and educational objectives; in decisions concerning the guidance, selection, and placement of students; and in decisions regarding instruction and evaluation. SAM was correlated with measures of cognitive activity, ratings from students' significant others, an index of within class academic engagement, and a measure of general self-esteem.

Through extensive field testing, the reliability estimates for internal consistency range from .91 to .95 for the total test, and for test retest (four weeks) from .80 to .89. Validity studies suggest strong convergent validity of specific subscales with other instruments that test only one aspect of affective development.

The 5 scales in SAM are:

1. Motivation for Schooling; the statements are concerned with the effect of the students reactions to past school experience upon their motivation in school.
2. Academic Self-concept Performance based; the statements are concerned with the students confidence in their academic performance.
3. Academic Self-concept Reference based; the statements are concerned with how students think of other people (teachers, family, friends) feel about their school performance and ability to succeed academically.
4. Students Sense of Control over Performance; the statements are concerned with students' control over performance; the statements are also concerned with students' feelings about being able to exercise control over situations that affect them at school and to take responsibility for the outcome of relevant events.

5. Students Instructional Mastery; This scale is about how students feel about their mastery of instructional skills. These skills deal with mastering those strategies and skills that help a student excel in academic performance.

The School Attitude Measure was selected because of the type of information that it provides and also because SAM's reasonable concurrent validity with other attitude measures (Dolan, 1983). In addition individual SAM scales had average correlations with students' relative standing in class, developing cognitive abilities, teacher ratings, parent ratings, academic peer rating, academic engagement and attendance rates ($.15<r<.60$).

Enrollment patterns.

It was necessary to study grade enrollment in order to have a clearer idea of the dropout rates for the two genders. Dropping out of school is caused by many factors, but the main cause in Zambia is the selection process after an external examination. For this study, Grades 1, 7, 10 and 12 were analyzed.

In this section, the actual number of students enrolled in school in Grades 1, 7, 8, 10, and 12 are shown. Students have to pass two external examinations while in school. These examinations are mainly for grade promotions. The percentage of students for each gender who are promoted is locally known as a progression rate. Progression rates are described and are shown in table form for both Grades 7 to 8 and 9 to

10. Subject enrollments are described for Grades 7, 9 and 12. A graph showing subject enrollments is also made for grade 12.

Grade 1 was selected to show enrollment differences for the two genders when they start school. The first external examination is at Grade 7. This level was selected in order to establish how many students reached this level and were able to write this examination. Grade 8 was selected to show how many students of both genders were able to go beyond the Grade 7 examination. The next external examination after grade 7 is Grade 9. Grade 10 was selected in order to show how many students of either gender passed the Grade 9 examination. Lastly, Grade 12 was studied because this is the last year of school and it was a good way of finding out the number of students of both genders who completed high school.

Data Collection and Recording

Scripts and marksheets for the samples were obtained from the Ministry of Education in Zambia. Grade 7 marks from the marked scripts were transferred to mark sheets and then to the computer. Grade 9 scores, already on mark sheets, were also keyed into the computer for analysis. The Grade 12 summary statistics were copied from the Ministry of Education records. SAM was administered to the sample over a period of two months with the help of two officials from the Psychological Service of the Zambian Ministry of Education. After the administration of SAM tests, the scripts were marked and made available for computer analysis. The data on grade and subject enrollment were simply copied from the Ministry of Education grade attendance and subject enrollment records.

Data Processing and Analysis

The alpha-level selected for this study was .05. SPSS version 4 for the Macintosh was used for the analyses. The analysis was as follows:

a) 2 x 2 ANOVA with gender (male and female) and locality (urban and rural) as independent variables. The dependent variables were English, mathematics and science scores for Grades 7 and 9. Interactions were plotted where present. Where significant interaction results were obtained, multiple range tests were used to compare cells.

b) Grade 12 summary statistics were refined to highlight the differences between male and female achievement in English, mathematics, advanced mathematics, English literature, chemistry, biology and physics. The percentage of males and females who obtained a particular subject category were calculated and compared.

c) The SAM scores were analyzed by gender and locality using descriptive methods.

d) Subject intercorrelations among the scores for English language, mathematics and science and the correlations between SAM were calculated.

e) Enrollment Patterns were summarized by gender.

The results of the data analyses are presented in the next Chapter.

Limitations of the study.

Because national examinations are held for Grades 7, 9 and 12 only, examination results for these grades were used in the analysis and only for the years in which proper records were kept. No records of the general ability levels of the students included in the sample were made available. Because these tests were based on the Zambian syllabus, the results could not be generalized to other countries.

Delimitations of the study

Due to financial and time constraints, it was not possible to test all the subjects for general ability. It was also not possible for the same reasons already given to develop an attitude survey based on the Zambian experiences.

CHAPTER IV

RESULTS

Introduction.

This study was undertaken to investigate differences in academic achievement and school attitude due to gender and locality in Zambian schools. Enrollment patterns were also investigated. In this chapter, results of the data analyses are given: ANOVA and descriptive statistics (mean, standard deviation, percentage), which are used to analyze gender differences in academic achievement. School attitude scores are presented for each of five scales. School attitude scores are correlated with achievement scores. Tables, figures, and summaries are used to explain enrollment patterns. The presentation of data in each case is preceded by reliability and validity reports on the instruments used.

Where ANOVA showed significant interactions, multiple range tests were used to determine which groups were significantly different.

Grade 7 Results.

Grade 7 English language test.

Reliability and validity of tests.

The reliability coefficient for this test was .83 (KR 20). The content validation includes description of the syllabus coverage, test specifications, skills required, performance required, questions response format, and the matching of items to test specifications. The content validation process follows closely recommendations made by Crocker and Algina (1986 pp 219).

The test specifications for Grade 7 English language examination covered all major sections of the syllabus that were testable. Some sections of the syllabus had more items than others depending on the amount of subject content and emphasis required by the examiners.

The test specifications for English language included eight sections. The first part was comprised of questions on use of pronouns, verbs, adjectives, conjunctions, and prepositions. The second part required interpretion of word and sentence meaning. The third part included spelling skills, followed by the fourth part on punctuation. The fifth part was on paragraph organization. The last three parts were on comprehension.

Examinees were expected to demonstrate a number of skills described in the test specification. The skills required for pronouns, verbs, adjectives, conjunctions and prepositions was understanding their correct usage. Word and sentence meaning, and spelling were grouped under comprehension skills. Punctuation and paragraph organization were placed under writing skills. Lastly, comprehension was placed under reading skills. In this study, items are grouped under a) usage, b) comprehension and c) reading and writing .

There was no minimum score or pass performance required. Each raw score from the six subjects was added to give a total student score. A student's score had to fall above a given cut off point in order for that student to be selected to go to secondary school. The six subjects considered were English, mathematics, science, social studies, special paper I and special paper II. All questions for all the tests were in multiple choice format. Students were required to write their answers on cards that were fed into an optical reader for marking.

The Grade 7 English language question paper met the standards specified in the test specification. This decision was arrived at after comparing items on the test to the categories given in the test specification.

Scores analysis: Grade 7 English.

The descriptive data on achievement, given in Table 1, compares the scores of males and females in urban and rural localities. The ANOVA results are given in Table 2. The analyses answer the following questions:

1) Do gender differences exist in English language achievement scores at Grade 7?
2) Do differences exist between Grade 7 Urban and Rural students in English language scores?

Table 1

Means and standard deviations for Grade 7 English language raw scores.

	Male	Female	
Urban	37.44 SD 11.27	37.20 SD 10.66	37.32
Rural	36.48 SD 12.40	26.60 SD 9.52	31.54
	36.96	31.90	

Table 2

ANOVA results for Grade 7 English by Gender and Locality

Source of variation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Locality	1115.560	1	1115.560	9.099	.003
Gender	432.640	1	432.640	3.529	.063
Loc/ Gender	384.160	1	384.160	3.133	.080
Residual	11769.600	96	122.600		
Total	13701.196	99	138.404		

The mean scores for rural females stand out as much lower than all the other groups (Table 1). The ANOVA results show that the locality of the students was significant ($F= 9.91$; $p= <.05$) but gender was not (Table 2). These results show that performance scores by urban students were superior to those of rural students. The difference in performance between genders was about 5%.

Differences in Grade 7 English scores by skills.

An additional question to be answered on Grade 7 English language score analysis was: Do gender and locality differences exist when items for the Grade 7 English language examination are grouped according to the given skills of Usage, comprehension, and Reading and Writing?

The Grade 7 English language test had the following items: 15 items on Usage skills; 10 on Comprehension skills; and 35 items on Reading and Writing skills. The scores and standard deviations for the three skills are shown in Table 3. Also shown in Tables 4, 5, and 6 are the ANOVA tables for the same skills.

The full descriptions of Usage, Comprehension, and Reading and Writing skills being analyzed are already given on page 58. These categories of skills are the same as those being used by the Zambian Ministry of Education.

Table 3

Means and standard deviations for Grade 7 raw scores for English skills.

	URBAN			RURAL		
	USAGE	COMP.	R&WRT	USAGE	COMP	R& WRT
Male	8.24 sd 2.71	5.36 sd 2.02	21.68 sd 9.02	8.52 sd 2.29	5.08 sd 1.79	24.2 sd 9.30
Female	10.2 sd 2.69	5.48 sd 2.14	20.8 sd 8.93	7.8 sd 2.13	3.80 sd 1.59	15.96 sd 7.9

Table 4

ANOVA results for Grade 7 English Usage skills.

Source of Variation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Locality	7.921	1	7.921	.587	.446
Gender	48.901	1	48.901	3.624	.060
Loc./Gend	36.026	1	36.026	2.670	.106
Residual	1282.053	95	13.495		
Total	1374.901	98	14.026		

Table 5

ANOVA results for Grade 7 Comprehension skills

Source of Var.	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	8.847	1	8.847	1.540	.218
Locality	11.512	1	11.512	2.003	.160
Gen/loc	25.156	1	25.156	4.378	.039
Residual	545.913	95	5.746		
Total	591.636	98	6.037		

Table 6

ANOVA results for Grade 7 English writing and reading skills.

Source of Var.	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	511.005	1	511.005	9.629	.003
Locality	337.965	1	337.965	6.368	.013
Gen/loc	51.246	1	51.246	.966	.328
Residual	5041.758	95	53.071		
Total	5991.974	98	60.720		

No significant gender results were found in Usage skills (Table 4) i.e. performance by males and females in these skills was about the same regardless of locality. The scores compared were those for the items which involved correct usage of pronouns, verbs, adjectives, conjunctions, and prepositions. Both rural and urban students performed about the same regardless of gender.

Significant interaction results were obtained for the Grade 7 English comprehension skills ($F=4.378$, $p<.05$) (Table 5) but no contrasts were required for this level of analysis. From the mean scores it was observed that in the urban schools, females performed about the same as male students but for rural schools, males performed better than females.

Both gender ($F=9.629$, $p<.05$) and locality ($F=6.368$, $p<.05$) gave significantly different results when the scores for writing and reading skills for Grade 7 English were compared (Table 6). Scores for males were higher than those for females. Similarly, urban students obtained higher scores than their rural counterparts.

Grade 7 mathematics test.

Reliability and validity of tests.

The reliability of the mathematics Grade 7 test for 1992 was .85 (KR 20). The content validation includes descriptions of syllabus coverage, test specification, performance required, questions asked and response format, and proportion of items matching test specifications.

The units in the item specification covered the entire Grade 7 mathematics syllabus. Some sections of the syllabus had more questions than others depending on the emphasis desired by examination setters. The item specifications were defined by both the content and skills. The content was subdivided into three sections: arithmetic, algebra, and geometry. The Arithmetic section includes the following: numeration and notation, addition and subtraction, multiplication and division, fractions, money averages, number base and number line, mass, and time. Questions under this section were distributed as follows: 4 Knowledge; 5 Comprehension; 14 Mechanical; and 17, Problem solving. The Ministry of Education uses the word "mechanical" to describe simple computational problems. Arithmetic problems contributed two thirds of the questions, or a total of 40 items, on this paper.

The algebra section includes the following sections: equations, inequalities and sets. In terms of the skills required, 3 questions required knowledge skills, 2 required comprehension skills, and 3 required mechanical skills. The total contribution of this section to the mathematics test was 8 items.

The geometry section include the following topics: perimeter, area, volume, measurement, interpretation of drawings and graphs, shapes and symmetry of angles. Under this section, there were no questions at knowledge level. There were 6 at comprehension, 2 at mechanical, and 4 at problem solving. This section contributed 12 items.

The overall total classification of items by levels is 7 at the knowledge level; 13 at comprehension; 19, at Mechanical, and 21 at the problem solving level, making a total of 60 items for the paper. Although basic functions such as addition, subtraction, multiplication and division were said to have contributed only 9 items, these operations were also reflected in many other items.

The contribution of mathematics scores to the overall student total score was important although the actual score in mathematics was not considered separately.

The format of all the questions was multiple choice. However, some questions required simple calculations using basic arithmetic skills and others required the understanding of mathematics concepts and their applications. Student answers were marked in pencil on computer answer cards. This paper met the requirements of the item specification by both content and skill.

The analysis answered the following questions:

1) Do gender differences exist in mathematics achievement at Grade 7?
2) Do differences exist between urban and rural students in mathematics?

The means and standard deviations for Grade 7 mathematics scores are shown in Table 7, the ANOVA is shown in Table 8, the interaction is shown in Figure 1, and the group contrast results are shown in Table 9.

Table 7

Means and standard deviations for Grade 7 mathematics raw scores.

	Male	Female	
Urban	37.80 SD 12.09	35.00 SD 10.36	36.40
Rural	38.72 SD 11.65	25.96 SD 10.80	32.34
	38.26	30.48	

* note: maximum score = 60.

Table 8

ANOVA results for Grade 7 mathematics scores analyzed by gender and locality.

Source of variation	Sum of Sq.	Mean DF	Mean Sq.	F	Sig. of F
Local	412.090	1	412.090	3.247	.075
Gender	1513.210	1	1513.210	11.093	.001
Local/Gendr	620.010	1	620.010	4.885	.029
Residual	12184.000	96	126.917		
Total	14729.310	99	148.781		

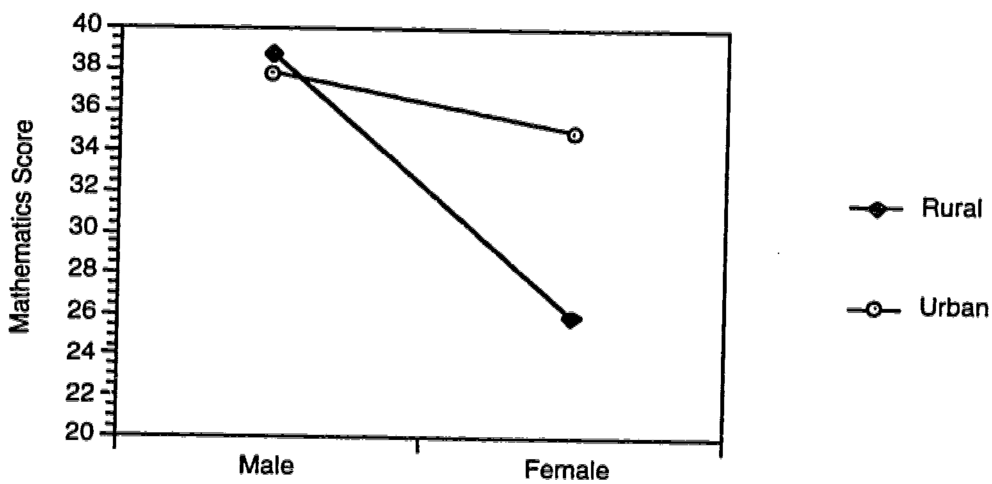

Figure 1. Interactions between gender and locality for Grade 7 mathematics

Table 9

Group contrasts for Grade 7 mathematics scores.

Mean	Group	FR	FU	MU	MR
25.96	FR				
35.00	FU				
37.80	MU	*			
38.72	MR	*			

*significant.

The means scores for Grade 7 mathematics reveal very poor performance by rural females (Table 7). Performance by the urban females was not very different from those of urban males and rural males. The ANOVA results for the Grade 7 mathematics scores show that there were significant interactions between locality and gender (F=4.88, p=<.05) (Table 8). There is a general trend for female students to score lower than male students regardless of their locality, with rural females students scoring significantly lower than urban female students. However for males, there is slightly better performance of rural males than for urban males (see also Fig. 1).

Group contrasts show that the difference in mathematics scores between rural females (FR) and rural males (MR), and rural females (FR) and urban males (MU) were both significant. The difference between the scores for female groups were non significant. Similarly, there was a non significant difference between the scores for urban males and rural males. Performance by the rural females was the poorest.

Analysis of Grade 7 mathematics scores by skills.

The specific question to be answered is: Do gender and locality differences exist when the mathematics paper is analyzed according to the categories of computing, geometry, and problem solving? Each of these category of skills had the following items: computing, 40 items; geometry, 12; and problem solving 8.

The means and standard deviations for the scores of all mathematics skill categories are shown in Table 10; the ANOVA for computation skills in Table 11; the ANOVA for geometry skills in Table 12; the ANOVA for the problem solving skills in Table 13.

Table 10

Means and standard deviations for Grade 7 mathematics skills raw scores.

	Urban			Rural		
	Comput.	Geom.	Prb.slv	Comput.	Geom.	Prb.slv
Male	27.72 sd 9.07	2.72 sd 2.30	7.28 sd 2.72	28.36 sd 10.38	2.88 sd 1.90	7.36 sd 2.31
Female	26.00 sd 9.05	2.68 sd 1.57	7.52 sd 3.31	17.56 sd 7.37	2.64 sd 1.85	5.88 sd 2.74

Table 11

ANOVA results for Grade 7 mathematics computation items.

Source of var.	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	906.010	1	906.010	11.110	.001
Locality	334.890	1	334.890	4.107	.045
Gend/loc	571.210	1	571.210	7.005	.010
Residual	7828.480	96	81.547		
TOTAL	9640.590	99	97.380		

Table 12

ANOVA results for Grade 7 mathematics geometry itemss.

Source of Var.	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	.490	1	.490	.133	.717
Locality	.090	1	.090	.024	.876
Gen/loc	.250	1	.250	.068	.795
Residual	354.880	96	3.697		
Total	355.710	99	3.593		

Table 13

ANOVA results for Grade 7 mathematics problem solving items.

Source of Var.	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	9.610	1	9.610	1.234	.269
Locality	15.210	1	15.210	1.953	.165
Gen/loc	18.490	1	18.490	2.374	.127
Residual	747.080	96	7.788		
Total	790.390	99	7.990		

The differences between the scores for male and females students in Grade 7 mathematics computation scores were significant (F=11.11, p=<.05). Males performed better than females. There were also significant differences between the scores for urban and rural students (F=4.107, p=<.05). Urban students performed better than rural students. The interaction results for Grade 7 computation skills were also significant (F=7.005, p=<.05). Rural females performed much poorer than their urban males and females, on the other hand, there was very little difference between the scores of the male groups. Non significant results were found when the scores for male students were compared to female students in Grade 7 mathematics geometry items. Similarly, non significant results were obtained when the scores for rural students were compared to those of urban students (Table 12). Non significant results were found for Grade 7 mathematics problem solving items when the scores for rural and urban students were compared. The differences between the scores for male students and female students in the problem solving category did not produce significant results either (Table 13).

Analysis of the Grade 7 science test.

Reliability and validity.

The reliability of the Grade 7 science test was .87 (KR 20). The content validation includes descriptions of syllabus coverage, the test specification, proportion of items matching to item specification, and performance required.

All the main units of the syllabus were generally well covered by the test items. The number of items generally reflected the amount of content to be covered and the importance attached to them by the examination setters.

The specifications indicate both content and skills to be covered in a test. Topics specified for this test include matter, man, weather, heat, water, forces, plants, animals, sound, communications, light, universe, ecology, farming, gases and energy. Under each topic, questions were asked which require a range of skills from knowledge, comprehension, application, and problem solving. Comprehension questions were given 40% of the weighting, followed by those requiring knowledge level skills which had 30%; application 20%; and problem solving, 10%.

The Grade 7 examination met the specifications required by the Ministry of Education. The score for the subject was only important in so far as it contributed to the overall total score for the six subjects. There was no minimum pass score required for Grade 7 science. About 30% of the questions (15) were based on information. The rest of the items (35) were on reasoning. The total number of items for the whole paper was 50. All questions were stated in multiple choice format and were answered on computer cards by marking the correct answer in pencil.

Analysis of Grade 7 science achievement scores.

The following results answered the following Questions: 1) Do Gender differences exist in Grade 7 science achievement at Grade 7? 2) Do differences exist between urban and rural students in Grade 7 science scores?

Performance on the Grade 7 science test analyzed according to gender and locality are shown in Table 14. The ANOVA data is given Table 15.

Table 14

Means and standard deviations for Grade 7 science raw scores

	Male	Female	
Urban	28.92 SD 9.30	28.04 SD 8.32	28.48
Rural	28.49 SD 9.70	18.40 SD 7.43	23.45
	28.71	23.22	

Table 15

ANOVA: Grade 7 science scores analyzed by gender and locality.

Source of variation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	1149.210	1	1149.210	15.078	.000
Local	349.690	1	349.690	4.588	.035
Loc/ Gender	204.490	1	204.490	2.683	.105
Residual	7316.800	96	76.217		
Total	9020.190	99	91.113		

The highest possible score for Grade 7 science was 50. The mean scores for urban male, rural male and urban female were quite close with raw score differences of less than one. The rural females had by far the lowest scores in the group. The raw score differences between urban males and rural females was 10.52. The highest scores were by urban males followed closely by rural males.

The ANOVA results show that the score differences between male students and female students were significant (F=15.078, p=.<05) (Table 15). Male student performance was superior to that of females. There were differences in the mean raw scores between urban and rural students and the former performed much better than their rural counterparts.

Analysis off Grade 7 science scores by skills.

The specific question to be answered is: (1) Do gender and locality differences exist when the items are divided according to the categories of skills : a) Information and b) Reasoning? The distribution of items according to the item specification was as follows: 12 for information and 38 for reasoning skills, giving a total of 50 items for the whole test. Each item was worth one mark.

The only significant difference in information scores were those between males and females (F=12.805, p=.<.05) (Table 17). Male students performed better than female students in information skill items. The score differences in reasoning skills between those for males and females were found to be significant (F=7.083, p=<.05) (Table 18). Male students clearly showed superior performance. Significant results were also recorded for the score differences between urban and rural students (F=4.734, p=<.05). In this case, urban students had higher scores than rural students.

Table 16

Mean scores and standard deviations for Grade 7 science skills.

	Urban		Rural	
	Information	Reasoning	Information	Reasoning
Male	11.64 sd 4.25	17.76 sd 5.36	10.68 sd 4.22	16.84 sd 5.82
Female	8.80 sd 4.79	16.08 sd 6.27	7.33 sd 2.99	12.17 sd 5.18

Table 17

ANOVA for Grade 7 science: Information skills

Source of Var	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	214.541	1	214.541	12.805	.001
Locality	44.303	1	44.303	2.644	.107
Gender/Loc	.363	1	.363	.022	.883
Residual	1574.927	94	16.755		
Total	1834.133	97	18.909		

Table 18

ANOVA for Grade 7 science: Reasoning skills.

Source of Var	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	229.592	1	229.592	7.083	.009
Locality	153.470	1	153.470	4.734	.032
Gender/loc	48.688	1	48.688	1.502	.223
Residual	3047.067	94	32.416		
Total	3478.816	97	35.864		

Grade 7 school attitude scores.

This test had a total of 85 items evenly divided among the five scales; Scale A through E have 17 items each. The students responded to one of the available alternatives: never agree, sometimes agree, usually agree, always agree. These alternatives are coded in the positive direction from 1 to 4 (i.e. always agree = 4). For some items due to negative wording, the reverse of this coding was required (i.e. Never agree = 4).

The means and standard deviations for the school attitude scores are shown in Table 19. The questions to be answered in this section are: 1). Do gender differences exist in SAM scores? 2). Do locality differences exist among SAM scores?

Table 19

School Attitude raw score means for Grade 7 students by gender and locality.

	SCALE A	SCALE B	SCALE C	SCALE D	SCALE E
Male	48.25 sd 8.6	52.50 sd 7.8	48.44 sd 6.9	47.75 sd 7.2	51.50 sd 7.3
Female	46.15 sd 8.0	48.03 sd 7.9	47.20 sd 6.5	45.35 sd 6.8	47.85 sd 6.9
Rural	45.40 sd 7.9	48.48 sd 6.9	47.50 sd 6.9	45.90 sd 6.2	45.55 sd 6.5
Urban	49.00 sd 8.5	52.05 sd 7.9	48.44 sd 7.2	47.75 sd 6.5	53.60 sd 6.7

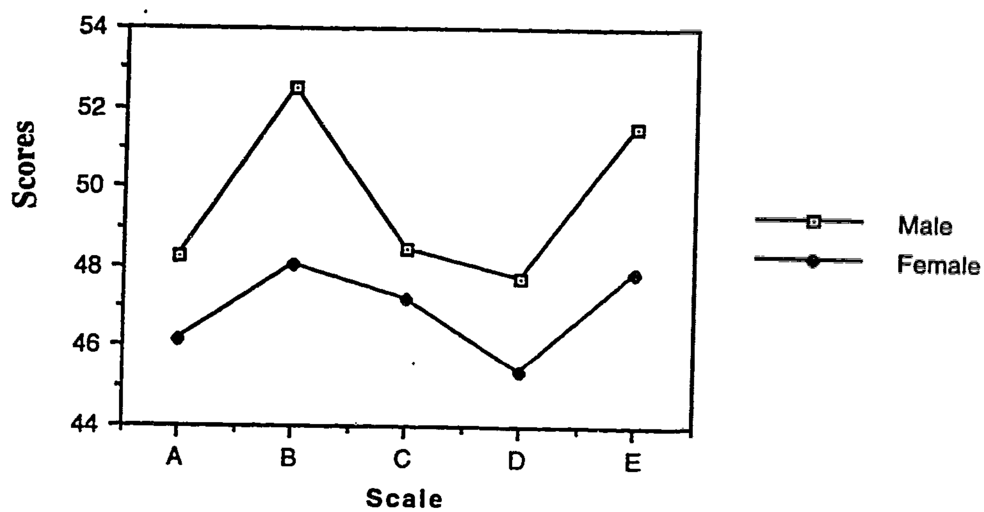

Fig. 2 Comparison of school attitude scores by gender.

The largest gender differences were found in scale B (self concept-performance based) followed by scale E (instructional mastery). The least gender differences were found in scale C (self concept-reference based). Males seemed to feel much more confident than their female counterparts. Females also reported insecurity in mastering instructional skills.

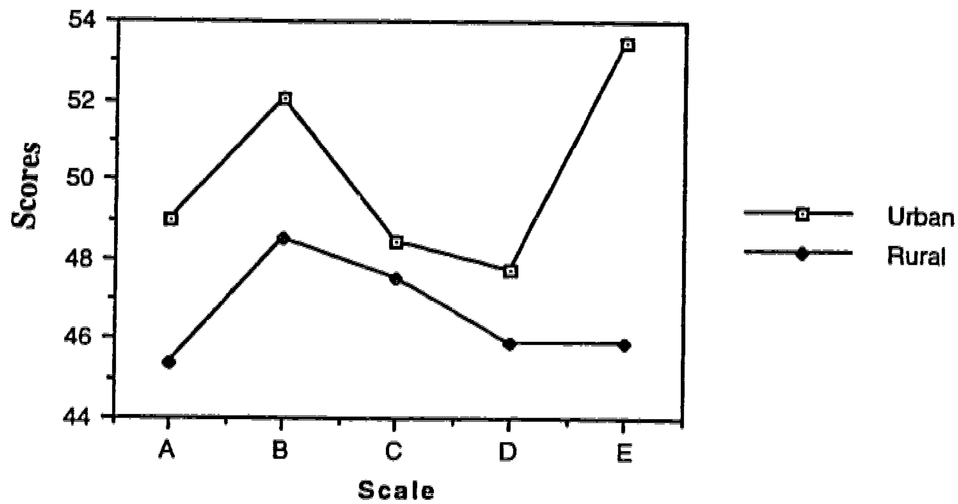

Figure 3. Comparison of school attitude scores by locality.

The largest locality differences were in Scale E followed by Scales B and A. Urban students reportedly felt confident about their mastery of instructions (Scale E); rural students reported the exact opposite. Urban students also seemed to feel much more confident in their school work than their rural counterparts (Scales A and B). The correlations between students' scores on SAM and their scores on the three achievement tests is shown in Table 20. The highest correlations were reported in mathematics. English scores had the lowest correlation with SAM scores. All the reported correlations are considered to be in the medium range.

Table 20

Correlation between Grade 7 examinations and SAM measure (N=100).

	ENGLISH	MATH	SCIENCE
SAM	.45	.61	.53

Grade 9 results.

English Language test

Reliability and validity.

The reliability of the Grade 9 English test was .73 (Cronbach alpha). The content validation includes description of syllabus coverage, skills required, performance required, response format, and degree of fit to test specification. The three examination papers for Grade 9 English were consistent with previous formats both in style and content. The questions covered all the major sections of the syllabus as required by the test setters.

In this examination paper, students were expected to comprehend and to follow oral instructions given to them by the examiner. Students were examined in aural skills for 15 minutes. In paper 2, students were required to demonstrate their ability to write short essays. 50 minutes were allowed for this section. The maximum possible mark for essays was

35. In paper 3, students were required to demonstrate comprehension of given passages by answering questions on them. The students were also required to make summaries of long passages. The maximum possible mark for paper 3 was 55.

Student were required to pass the English language examination in order to advance to Grade 10 and to receive a full certificate, in addition to passing in five other subjects. The score required to pass the examination was not fixed prior to administration of the examination. The chief marker set the "pass mark" after reviewing the distribution of the scores from each examination.

There were no written specifications for setting this paper except a tradition to adhere to previous formats. The people who created the examination followed closely the previous formats. Both the structure of the paper and the number and type of questions remained the same as in previous years.

Analysis of Grade 9 English test scores.

English language scores for Grade 9, analyzed to compare differences in gender and locality are shown in Table 21. The ANOVA for Grade 9 English language scores is shown on Table 22.

Table 21

Mean and standard deviations for Grade 9 English raw scores.

	Male	Female	
Urban	53.36 sd 17.05	48.32 sd 16.08	50.84
Rural	51.48 sd 17.04	43.72 sd 16.69	47.60
	52.42	46.02	

Table 22

ANOVA: Grade 9 English language scores.

Source of variation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	1024.000	1	1024.000	3.484	.065
Local	262.440	1	262.440	.893	.347
Loc/Gender	46.240	1	46.240	.157	.693
Residual	28214.480	96	293.901		
Total	29547.160	99	98.456		

The highest scores in Grade 9 English were obtained by urban males. The scores for rural males were second. The lowest scores were obtained by rural females. The highest possible score in Grade 9 English language was 100. The ANOVA results show that there were no gender or locality differences that were significant (Table 22); however, rural females had much lower scores in Grade 9 English than all the other groups.

Grade 9 mathematics test.

Reliability and validity.

The Grade 9 mathematics test had a reliability of .87 (Cronbach alpha). The content validation is described using information on syllabus coverage, response format, skills required, performance required, and degree of fit to specification. The items in this test covered all parts of the Grade 9 syllabus. Paper 1 contained 30 questions, 6 on geometry, 4 on fractions, 2 on algebra, 12 on problem solving, and 6 on basic arithmetic functions such as addition, subtraction, multiplication and division. Paper 2 was designed to test students' ability to do complicated mathematics involving long calculations. Students were only expected to answer 5 out of 8 questions in paper 2. The total marks possible for the two papers was 100.

Students were expected to write down the answers to all the questions on the answer sheets provided. In paper 1, only correct answers were awarded marks. In paper 2, students were required to show all the steps of their calculations on sheets of paper which were provided. Correct steps in the calculations were awarded marks even if the answer was wrong in the end.

Basic arithmetic skills of addition, subtraction, addition and multiplication were required. Also, students were expected to solve geometric problems such as calculating the length of a side of a figure, calculating the area, perimeter and diagonal of given figures. Students were also required to solve ordinary and simultaneous equations and to understand power functions. There was no minimum passing mark set prior to administration of the examination. The chief examiner decided what constituted a failure, a pass, a credit or a distinction. Although there was no item specification, the test people who set the test questions were expected to adhere to previous styles and to include only items from the syllabus.

Grade 9 mathematics score analysis.

In Grade 9 mathematics, the highest scores were obtained by urban males (Table 23). The second highest scores were for rural males. The rural females had by far the lowest scores of any group. There was a difference of about 27 percentage points between urban males and rural females. The difference between urban females and rural female students was about 16 points. Gender differences were found to be significant (F=30.888, p=<.05). The interactions between gender and locality were also significant (F=24.305, p=<.05) (Table 24). The interactions show that male students performed well regardless of locality. Female students tend to score lower in general but much lower in rural areas (see Figure 4). Group contrasts revealed that both rural and urban females had scores that were significantly different with each other and both male groups. On the other hand, the differences in scores between the male groups were non significant (see Table 25).

Table 23

Means and standard deviations for Grade 9 mathematics raw scores.

	Male	Female	
Urban	47.88 sd 8.80	35.96 sd 10.67	41.92
Rural	44.00 sd 8.19	21.92 sd 9.19	32.96
	45.94	28.94	

Table 24

ANOVA: Grade 9 mathematics scores analyzed by gender and locality.

Source of variation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	7225.000	1	7225.000	30.888	.000
Local	27.040	1	27.040	.116	.735
Loc/Gender	5685.160	1	5685.160	24.305	.000
Residual	22455.440	96	233.911		
Total	35392.640	99	357.501		

Table 25

Group contrasts for Grade 9 mathematics scores.

Mean	group	FR	FU	MU	MR
21.92	FR				
35.96	FU	*			
47.88	MU	*	*		
44.00	MR	*	*		

* significant.

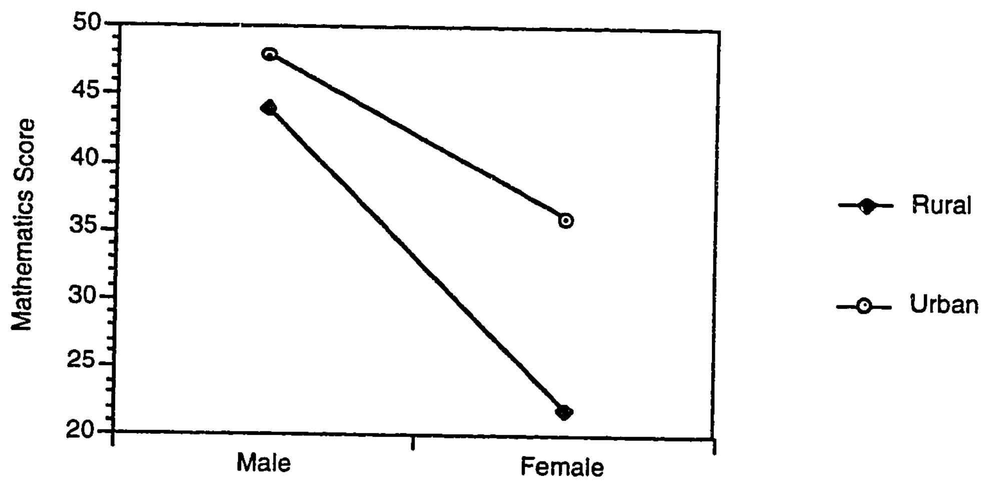

Figure 4. Interactions for Grade 9 mathematics presented by gender and locality.

The difference in Grade 9 mathematics scores between female groups was much larger than that for male groups (Figure 4). Performance by females was much poorer than that of males regardless of locality. The performance by rural females was by far the poorest compared to all the groups. On the other hand, males performed much better than females regardless of locality.

Grade 9 science test.

Reliability and validity.

The Grade 9 science achievement test had a reliability of .84 (Cronbach alpha). The content validation includes descriptions of syllabus coverage, skills required, response format and degree of fit to test specification. There were 2 papers for Grade 9 science. Paper 1 consisted of short questions that covered the entire syllabus. In paper 2, students were required to show deeper understanding of scientific concepts through descriptions of scientific phenomena and labeling diagrams. Paper 1 was of multiple choice format. It was, however, marked by hand as the answer sheet was not designed for computer marking. The second paper consisted of short descriptions of concepts, labeling diagrams and figures, and problem solving items. This test covered items from within the syllabus. It was similar in style and content to previous formats.

The mean scores for Grade 9 science achievement test are shown by gender and locality in Table 26; the ANOVA results are shown in Table

27. The maximum score in Grade 9 science was 100. The ANOVA results show that there were significant differences between males and females (F=32.827, p=<.05). Males had superior scores. The average scores for urban and rural females were significantly different from that of urban and rural males. Males as a group had higher scores than females.

Table 26

Means and standard deviations for Grade 9 science.

	Male	Female	
Urban	57.00 sd 15.67	38.88 sd 13.46	47.94
Rural	58.44 sd 13.40	40.40 sd 15.74	49.42
	57.72	39.64	

Table 27

ANOVA: Grade 9 science scores.

Source of vriation	Sum of Sq.	DF	Mean Sq.	F	Sig. of F
Gender	8172.160	1	8172.160	32.827	.000
Local	54.760	1	54.760	.220	.640
Local/Gendr	.040	1	.040	.000	.990
Residual	23898.800	96	248.946		
Total	32125.760	99	324.503		

Grade 12 examination results.

The analysis of Grade 12 results was made without access to inddividual raw scores. Only the summaries were provided to the researcher by the Zambian Ministry of Education. The results are presented by the categories of distinction, merit, credit, pass, and fail.

The actual number of students whose scores placed them in the categories of merit are shown in Table 29. The category percentages for each subject are shown in Table 28. In all these subjects except in English language and English literature, a higher percentage of males obtained the distinction and merit grades. The actual numbers show that there were also more males than females who obtained the distinction and merit grades in all subjects except English literature where more females than males were in the distinction category.

Table 28

Grade 12 1989 examination results by gender and category of mark awarded.

		Category				
Subject	Gender	% Disti-nction	% Merit	% Credit	% Pass	%Fail
English	MALE	4.41	14.08	19.92	34.22	27.37
	FEMALE	6.06	17.17	23.21	40.39	13.17
English Lit	MALE	17.12	25.04	24.27	22.77	10.81
	FEMALE	19.81	31.28	24.52	17.57	16.85
Math	MALE	9.39	20.78	20.06	16.14	33.62
	FEMALE	1.70	6.94	11.88	14.07	65.40
Add.Math	MALE	9.88	37.43	20.66	18.56	13.47
	FEMALE	0.00	0.00	25.00	0.00	75.00
Physics	MALE	2.36	16.75	21.17	36.46	23.26
	FEMALE	0.79	6.57	15.79	27.63	49.21
Chemistry	MALE	7.23	25.04	23.61	32.07	12.05
	FEMALE	6.28	18.32	19.90	25.13	30.37
Biology	MALE	3.45	14.55	19.72	35.62	26.65
	FEMALE	1.29	7.49	13.04	34.00	44.19

Note: the percentage calculations exclude absentees.

Table 29.

Frequency Distributions of Grade 12 students by subject, gender, and category.

SUBJECT	GENDER	Distinction	Merit	Credit	Pass	Fail	Absent	Total
English	male	627	2001	2832	4865	3891	421	14216
	female	326	923	1248	2172	708	244	5377
Eng.Lit	male	445	651	631	592	281	288	2600
	female	450	712	558	400	156	204	2276
Math	male	1096	2425	2341	1883	3923	502	11668
	female	90	367	628	744	3457	321	5286
A. Math	male	33	125	69	62	45	318	334
	female	0	0	1	0	3	48	4
Physics	male	70	496	627	1080	689	195	2962
	female	3	25	60	105	187	36	381
Chem.	male	222	769	725	985	370	183	3071
	female	24	70	76	96	116	59	382
Biology	male	364	1533	2078	3753	2808	514	10536
	female	62	360	627	1635	2125	280	4809

Note: the total column excludes absentees

Descriptions of performance by subject for the Grade 12 examinations.

Performance in English Language

The number of males who obtained distinction was 627 or 4.41% of the male students who actually wrote the examination (see Tables 28 and 29).

On the other hand, the number of female students in this category was 326 or 6.06% of all female examinees. At the merit level, there were 2001 males students who made up 14.08% of the male student population compared to 923 or 17.17% of the female student population.

The distinction and merit groups form an elite class of students from which university students are drawn. Students must obtain a distinction or merit level on the English language achievement examination in order to gain entry into the local university in addition to achieving similar grades in four other examinations.

The third category is credit. In this category, there were 2,832 males (19.92%). The number of females was 1,248 (23.31%) which is 1,584 less than the number of males. It is mainly from this category that 2 and 3 year Colleges recruit their students.

The fourth category is pass. In this category, there were 4,865 males (34.22%) compared to 2,172 (40.39%) females. Pass level is only useful for certification purposes. In the past when competition for college was less competitive, some students in this category were recruited by colleges.

Performance in mathematics

A total of 11,668 male students wrote the mathematics examination compared to 5,286 female students. Mathematics, like English, is a compulsory subject. The difference between the number of students who wrote the mathematics and English examinations represent those who wrote the English test but failed to write the mathematics examination for unknown reasons.

The number of males in the distinction category was 1,096 (9.39%) compared to 90 (1.70%) females. Those who qualified for the merit category were 1,434 males (20.78%) compared to 367 (6.94%) females. The total number of male potential candidates for university entry based on this subject was 2,520 males compared to 457 females.

The number of males in the credit category was 2,341 (20.06%) compared to 628 (11.88%) females. There were 1,713 more males than females in this category. In the pass category, there were 1,883 males (16.11 %) and 774 (14.07%) females. The number of males exceeded the number of females by 1,139 in this category.

Performance in additional mathematics

This subject is taken by only the very best students in regular mathematics courses. There were no females in either the distinction and merit categories. Only one female received a credit level score out of a total of 52 females. The rest of the students either failed or were absent. A total of 33 males (9.88%) got distinction, 125 got merit (37.43%), 49 got credit (20.66%) and 62 (18.56%) got passes. The rest failed or were absent.

Students who do well in this subject have no advantages in terms of consideration for university studies other than that the experience of dealing with more advanced concepts may help them in their study of Mathematics at more advanced levels.

Performance in physics

In 1989, 2962 male students wrote the examination compared to 381 female students. About 20.83% of the male students entered for the physics examination compared to only 7.09% of females. A total of 70 (2.36%) male students and 3 (0.79%) female students obtained distinctions. In the merit category, there were 496 males (16.75%) compared to 25 (6.57%) females. A total of 627 males (21.17%) and 60 (15.79%) females were in the credit category. There were 1080 males (36.46%) compared to 105 (27.63%) females in the pass category. In physics, only 566 males and 28 females would have been eligible for university entry. The females represented 4.71% of all eligible university candidates in this subject.

Performance in chemistry

There were 3071 (21.60%) male students compared to 382 (7.10%) female students who wrote the Grade 12 chemistry examination in 1989. The number of males and females who obtained distinctions were respectively 222 (7.23%) and 24 (6,28%). In the merit category there were 769 males (25.04%) compared to 70 (18.32%) females. The number of students in the credit category were 725 (23.61%) males and 76 (19.90%) females. Lastly, the students in the pass grade were 985 males (32.07%) and 98 (25.13%)

females. A total of 1,191 males and 94 females were eligible for University entry. Females formed 2.68% of all eligible candidates in this subject.

Performance in Biology

The number of students who wrote the examination in biology was 10536 males and 4809 females. These figures mean that 74.11% of the males and 89.44% of the females wrote this examination. This was by far the highest entry by both gender in any subject.

Those in the distinction category were 364 males (3.45%) and 62 females (1.29%). In addition, 1,533 or 14.55% of the males got merit compared to 360 (7.49%) females. In the credit category, there were 2,078 males (19.72%) compared to 627 (13.04%) females. Lastly, those in the pass category were 3,753 (35.62%) males and 1,635 (34.00%) females. In biology, 1,897 males and 422 females obtained acceptable grades for university entry.

Performance in English Literature

Females had slightly higher percentages than males in the distinction, merit, and credit categories. Out of a total entry of 2,600 males, 2,319 or 89.19% of them got at least the minimum pass. On the other hand, the total entry for females was 2,276 out of which 2,120 (93.15%) got the minimum pass. For the various categories, the performance was as follows: distinction, 445 (17.12%) males compared to

450 (19.81%) females; merit, 651 males (25.04%) compared to 712 (31.28 %) females; credit, 631 (24.27%) males compared to 558(24.52%) females; pass, 592(22.77%) males compared to 400(17.57%) females. The differences are not very large but the performance by females in this subject is by far the best in any subject.

School Enrollment Patterns.

Grade Enrollments

Grade enrollment in selected grades are shown in Table 30.

Table 30

Grade Enrollment for Grades 1, 7, 8, 10 and 12 from 1990 to 1992.

1990	Grade 1	Grade 7	Grade 8	Grade 10	Grade 12
Male	123525	104730	39227	14059	12347
Female	120365	82349	22065	8257	6361
1991					
Male	129203	99724	39220	16663	12983
Female	126726	84411	26556	7284	6539
1992					
Male	133202	95990	42228	16951	14303
Female	130722	94913	28152	9140	6965

Descriptions of enrollments by Grade.

Grade 1 enrollment.

The figures shown in Table 30 indicate that between 1990 to 1992, there were 8117 more males than females who registered in Grade 1. The actual increase in male Grade 1 entrants for this period was 9,677 males compared to 10,357 females.

Grade 7 enrollment.

In 1990, there were 22,381 more males than females enrolled in Grade 7. In 1991, the number of males in excess of female enrollment was 15,313. The difference in enrollment, which was still in favor of males, was even smaller in 1992 when it was only 1,077. There was an actual increase of 12,564 in female enrollment between 1990 and 1992. On the other hand, male enrollment decreased by 8,740 giving a net gain of 3,824 females in the three year period.

Grade 8 enrollment.

There were more males enrolled in Grade 8 from 1990 to 1992. The excess number of males enrolled in comparison to females were 17,162 in 1990, 12,664 in 1992, and 14,076 in 1993. The actual enrollment increased by 3,001 for males and 3,086 for females, a net gain of 85 females.

Grade 10 enrollment.

The difference between male and female enrollment in 1990 was 5,802 in favor of males. In 1991, this difference rose to 9,379. The differences was reduced to 7,811 in 1992 but was still in favour of males. The increase in the number of females enrolled for this period was 883 compared to 2,892 for males. Male enrollment increased by a larger margin compared to females.

Grade 12 enrollment.

In 1990, there were 5,986 more males than females in Grade 12. Females were 34.00 % of the total student enrollment in 1990. In 1991, the difference between male and female enrollment increased to 6,444. Females made up 33.00% of the student population in 1991. The difference in enrollment for 1992 in favor of males increased to 7,338. Female enrollment in 1992 made up 30.7% of the entire Grade 12 student population. The gender gap in enrollment at all levels has remained the same in the last few years.

To illustrate the gender differences in enrollment figures from Grades 1 through 12 in 1992 see Figure 5.

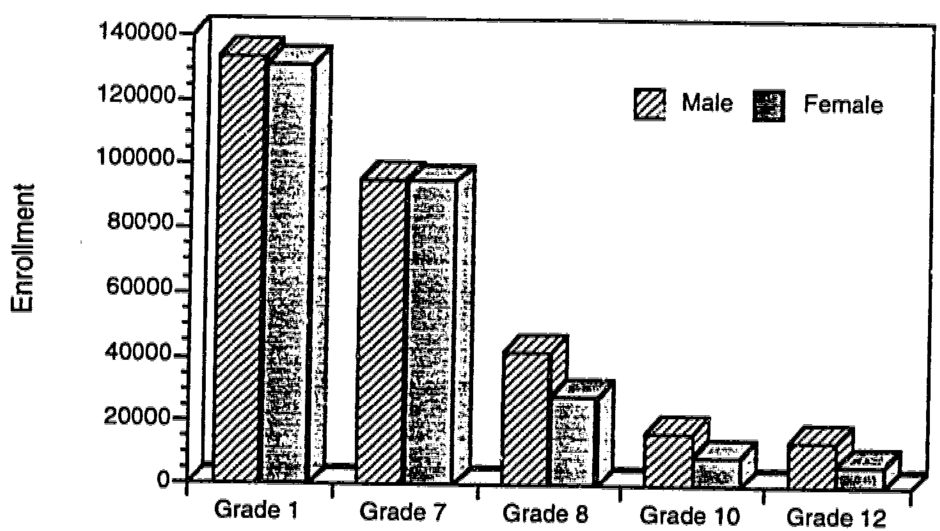

Fig. 5 Grade Enrollment for Grades 1, 7, 8, 10, 12 for 1992.

Gender differences in Grade enrollment existed in 1992 at all levels as shown in Figure 5. The gender differences in enrollment were small in Grades 1 and 7. Large differences occurred in Grades 8 through 12. Examinations at Grade 7 which were used for grade promotion purposes largely account for the differences.

Progression rates.

Progression rates from Grade 7 to 8 by gender for the period 1972 to 1992 are shown in Table 31. Progression rate represents the percentage of females or males promoted to the next grade. The progression rates for Grade 9 to 10, from 1988 to 1992 are shown in Table 32. More males than females went to Grade 9 in 1972, 1978, 1980, 1984, and 1992. Females made tremendous gains in enrollment. Progression rates for females improved over the years (Table 32). At Grade 9, there more males than females who went to Grade 10 from Grade 9 every year from 1988 to 1992. The percentages of females promoted to Grade 10 from Grade 9 increased by 3.4% during this period.

Table 31

Grade 7 to 8 Progression rates for 1972 to 1992.

Year	No. of Females	Female rate	No. of Males	Male rate
1972	46883	22.90	68393	22.80
1978	52457	21.10	76903	18.10
1980	68118	31.50	94049	27.40
1984	71401	36.23	96781	30.78
1992	94913	33.00	95990	42.21

Table 32

Grade 9 to 10 Progression rates for 1988 to 1992.

Year	Males	Females	Diffe-rence	Total selected	Females as % selected
1988	8795	4818	3977	13613	35.0
1989	9340	5600	3740	14940	37.5
1990	10059	6085	3974	16144	37.7
1991	10436	6272	4164	16708	37.5
1992	10355	6457	3898	16812	38.4

Subject Enrollments in Grades 7, 9 and 12.

In this study, it was only possible to analyze the enrollments by gender at each level. It was not possible to follow individual students from Grade 7 to 12 due to lack of available records. Following individual students would have made it possible to analyze how the choice of subjects at lower levels affected each student's performance later. With the data available, it was only possible to analyze the type of subjects preferred by each gender whenever there was a choice available to students.

At Grade 7 all the examination subjects were compulsory. The subjects taken include English language, mathematics, science, social studies, special papers 1 and 2, and a local language. The local language scores were not considered when calculating Grade 8 grade promotion points.

At Grade 9, the subjects taken were English language, mathematics, science, geography, history, civics, a local language, French, homecraft, woodwork and very rarely metalwork. Home craft was taken exclusively by females. Very few females took Woodwork and Metalwork. Students were expected to take nine subjects which included, English, mathematics and a science subject. They were free to choose the remainder of the subjects to make up the nine required. Geography, civics, and history roughly attracted the same number of male and female students. Woodwork and metalwork were dominated by males just as home craft was dominated by females.

Of all school levels, Grade 12 shows most variation in individual subject enrollments primarily because students in Grade 12 are permitted to choose from more subjects. The 1989 Grade 12 Subject Enrollments in selected subjects by gender are shown in Figure 6.

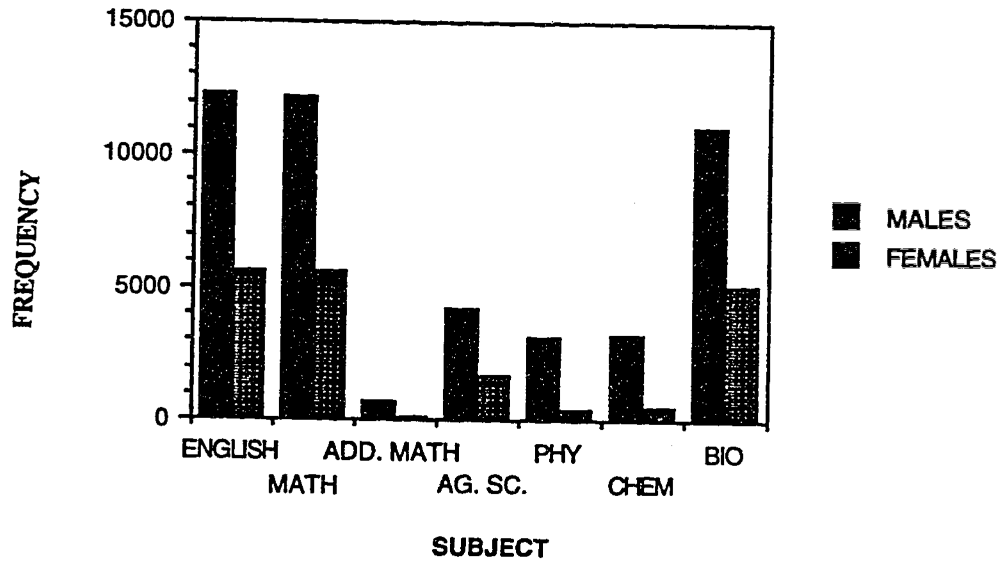

Figure 6. Grade 12 enrollments in selected subjects for 1989.

As English language was compulsory, the number of students who wrote this examination are assumed to represent all students who were actually presented by schools as examination candidates on examination day. Students who drop out of the school system between the time the school is initially approached to present lists of examination candidates, which is usually at the beginning of the year, and the time students actually write the examination are all considered absentees. Based on this information, 12224 of the student population actually wrote the Grade 12 examination in English.

In mathematics, 11668 males and 5286 females wrote the examination. In additional mathematics, there were only 334 males and 4 females. Additional mathematics was available only to the most talented mathematics students. There were big differences in the numbers of males and females who wrote physics and chemistry examinations. There were 2962 males and 381 females who took the physics examination. In chemistry there were 3071 males and 382 females who wrote the examination. Biology was by far the most preferred subject with 10536 males and 4809 females taking the examination. 1989 was selected for this illustration rather 1992 because complete information was available for that year. Enrollment in agricultural science showed that it was a more popular subject than either physics and chemistry.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Introduction

The discussion of the results presented in this chapter relates to the literature reviewed in Chapter 2, the questions asked in Chapter 3 and the results presented in Chapter 4.

Contained in this chapter are the following: a brief introduction, overview of the findings, a discussion of results as they relate to each question or hypothesis, limitations of the study, implications of the study, and recommendations for further research. The purpose of this study was to investigate the presence of gender differences in academic achievement, school attitude, locaality, and enrollment patterns in Zambian schools.

English language, mathematics and science were selected for two reasons. Firstly, according to the Zambian Ministry of Education (1977) these subjects are regarded as most important to the country's economic development. Secondly, research literature (e.g., Maccoby and Jacklin, 1966, 1974) has identified mathematics and science as most affected by school attitude. The School Attitude Scale was used as a measurement instrument of school attitude because of the relevance of its content. Enrollment patterns were included in the study because they show how the two gender differ in terms of number of students enrolled in each grade. Enrollment patterns also reveal the subjects of choice for each gender.

The subject choices are not only indicative of interest and ability of the student, but also help define career choices (Brush & Wilson, 1985).

Overview of Findings.

The ANOVA results showed gender differences in English Language for both Grades 7 and 9. Locality was however significant for Grade 7 English with the urban students showing superior performance. Small gender differences in favor of females occurred at Grade 12 in English language and English literature. Significant gender differences in mathematics scores were present at both Grade 7 and 9. In both cases, the interaction effects of gender and locality were also significant. Grade 12 results show that males performed much better than females in mathematics and additional mathematics. Significant gender differences were present at both Grades 7 and 9 in science. At Grade 12, males outperformed females in all the three science subjects i.e., chemistry, biology, and physics. On the average, males scored higher than females in both mathematics and science through out the school system.

Female students had lower school attitude scores. Large differences in favor of males were in scale B (Self concept performance based) and scale E (Instructional mastery) of the SAM. There were locality differences in favor of urban students in all scales. Particularly large differences were found in scales E (instructional mastery), A (motivation for schooling), and B (self concept-performance based).

There was a progressive decrease in enrollment numbers between Grades 1 and 12 for both genders. There were more males than females through out the school system especially at higher grades. There was a much higher percentage of males taking science subjects at higher levels of the school system.

All subjects at Grade 7 were compulsory except for local languages. At Grade 9, the majority of the subjects were open to both genders. There was a very limited choice of subjects at this level. At Grade 12, more males sat for science subjects i.e., physics, biology, and chemistry. Biology was the most popular subject with over 70% enrollment for both genders who were in Grade 12 in 1989. English Language and mathematics were compulsory at this level.

In the following pages, results are presented for each of the six questions.

Question One.

Do gender differences exist in Grade 7 English language, mathematics, and science achievement scores and in the selected skills in the same subjects?

Grade 7: English Language.

The ANOVA results (Table 2) show that there were non significant gender differences in Grade 7 English Language scores. Rural females had lower scores than urban males and urban females.

These results support the observations made by Halpern (1986), Lips and Colwill (1978), and Maccoby and Jacklin (1966, 1974), who all reported that gender differences in languages are very small and likely to be non significant. These researchers also observed that gender differences in languages tend to be very small especially in the preteen years. In adulthood, males tend to close the gap. Students who wrote this examination were between 12 and 14 years.

It is hard to tell if these results are in complete agreement with the observation made by Kelly (1991) because of the different methods used in analyzing the results. Both the results of this study and those of Kelly showed marginal differences between the means for males and females in Grade 7 English scores. The analysis by Kelly did not refer to significant levels as ANOVA was not used. There is no reference to locality differences in the review of literaure.

When the scores were analyzed according to the skills of Usage, Comprehension and Reading and Writing, male students performed much better than their female counterparts in reading and writing skills but only non significant gender differences occurred in usage and comprehension skills. Urban students performed significantly better than rural students in reading and writing skills. In the analysis of comprehension skills, the interaction effects were significant. Urban females had higher averages than urban males, on the other hand rural males performed better than rural females.

These results are contrary to the observations made by Maccoby and Jacklin (1974) who noted that females showed superior performance in basic language and in reading processing. The observations by Maccoby and Jacklin that males showed superior performance in vocabulary and semantic processes do not seem to have been supported by the results of this study.

Grade 7 Mathematics.

The ANOVA results show that gender and interaction effects were significant for Grade 7 mathematics. Performance by males was better than that for females regardless of locality. Rural females performed much poorer than their urban counterparts in this subject.

The results obtained are in agreement with the observations made by Maccoby and Jacklin (1974), who noted that moderate gender differences in quantitative ability begin to show from 12 years. Randawa (1991) noted that gender differences in quantitative ability at junior high level are mixed but when they occur, they are small and non significant but are in favor of males. The results obtained in this study showed substantial gender and interaction differences which were both significant. These results also support the observations made by Kelly (1991) who noted that in Zambia, Grade 7 male students consistently perform much better than their female counterparts in mathematics. The observation by Boswell (1985) that females performed better at Grade 7 or at primary level because problems in mathematics at that level were serial was not upheld.

When the Grade 7 mathematics results were analyzed according to items categorized by the skills of Computing, Geometry and Problem Solving, the only significant differences both by gender and locality were in the first category i.e. Computing. The gender and locality interaction effects were also significant for Computing.

These results only partly agree with the observations made by Hyde (1981) and by Halpern (1986) who observed that females in the 12 to 14 year old group exhibited superior performance in computation in comparison to males in the same age group. Urban females performed slightly better than urban males. Rural females scored much poorer than all the other groups. Contrary to observations by Halpern (1986) and Hyde (1981), males and females performances were not very different in problem solving although the scores for males were slightly higher. The observed results agree with those of Randawa (1991) who found that there were non significant gender differences for all problem solving items at this level.

Grade 7 science.

ANOVA results for Grade 7 science show that both gender and locality were significant but not the interactions. Male students performed better than female students and urban students performed better than rural students. These observations are consistent with those made by previous researchers such as Erickson and Farkas (1987), and Bullock Whitt and Beebe (1991), who noted that gender differences existed in science skills and competence in this age group.

The International Association for Educational Assessment (IEA, 1988) reported that in all the 24 countries they studied, males outscored females in science at all levels of the school system. IEA also noted that from about 10 to 14 years, differences in scores actually widened in favor of males. Hyde and Linn (1986) also noted that in the USA, males showed superior performance to females in the 13 to 17 year old group. The results of this study are also in agreement with Kelly's (1991) observation which indicate that males in Zambia perform better than females in science at this level. There are no relevant studies on locality differences cited in the review of literature.

When scores were analyzed according to skills, significant gender differences were found in both information and reasoning skills. Locality was significant for reasoning skills. Urban students had superior scores in this category of skills. The results obtained in this research support the observations made by Steinkamp and Marcher (cited in Linn & Hyde, 1986) who noted that males perform much better than females in information items at ages 13 to 17 years. The observations by Hyde and Linn (1986) which showed that gender differences in reasoning items are very small and non significant were not upheld as the gender differences were found to be significant in this study.

Question 2.

Do gender differences exist in Grade 9 English, mathematics and science achievement scores?

Grade 9 English Language.

Gender was non significant for Grade 9 English Language scores. Previous studies by Maccoby and Jacklin (1966, 1974), Halpern (1986) and Randawa (1991) show that gender differences in favor of females occurred in North America in students 12 years and older in both spoken and written English. Students who wrote this examination were 16 years old. The results obtained in this study are therefore contrary to previous studies already cited since female superiority in performance was not apparent. Since ANOVA results for Grade 9 English language did not produce any significant results, no group contrasts were done.

Grade 9 Mathematics.

Grade 9 ANOVA results for mathematics show that both interaction of gender and locality, and gender were significant. This means that although locality on its own was non significant, it had combined significant effects with gender.

Group contrasts show that both urban and rural females had significant differences with all other groups Male urban students had the highest scores followed closely by rural males. The mean score for urban females, although lower than the means for both male groups, was considerably higher than the mean score for rural females. There were non significant differences between the male groups.

The results obtained are generally supported by the research results of Maccoby and Jacklin (1974), and Halpern (1986) who noted that gender differences in mathematics are present in persons 16 years and older. The observations made by the IEA (1988) that gender differences exist in mathematics at this level are consistent with the observations made in this study. Randawa (1991) recorded mixed results in mathematics performance in this age group.

Grade 9 Science.

ANOVA results for Grade 9 show that gender was significant for Grade 9 science scores. Male scores were higher than those for females. The significant gender difference in Grade 9 science observed is consistent with the observations made by the IEA (1988) who noted that gender differences in junior high school existed in science in all the 24 countries they studied and were all in favor of males.

Studies in Zambia by Kelly (1991) show that males at junior high school level perform much better than their female counterparts in science. The results of this study therefore agree with those of Kelly.

Question 3.

Do gender differences exist in Grade 12 English language, mathematics and science achievement results?

Grade 12 English Language.

A review of the Grade 12 results shows that females performed slightly better than males in English Language. The percentages of females in the distinction and merit categories were slightly higher than that for males.

In a related subject, English Literature, a higher percentage of females than males obtained higher grades. In contrast to other subjects where female enrollment was small, the enrollment in English Literature was quite substantial and comparable to that of males.

Performance in English language by females at this level was only slightly better than that for males. The results of this study do not conclusively support the observations made by Maccoby & Jacklin (1974), Linn & Petersen (1986) and Elwood, Stobard, Anlan (1992) who observed that females demonstrate considerable superiority in both written and spoken English in their late teens. Students who wrote the Grade 12 English examination in Zambia averaged 19 years.

Grade 12 Mathematics.

On examining student performance in Grade 12 mathematics, it becomes clear that male performance was far superior to that of females. Only a very small percentage of the females compared to males obtained the prestigious distinction grades. The trend was similar in both the credit and merit categories. this subject was compulsory for all Grade 12 candidates.

These results confirm the observations made by Maccoby and Jacklin (1974), Randawa (1991) and those of IEA (1988) who observed that large gender differences in mathematics achievement exist in the late teens. Students who wrote this examination were between 18 to 19 years old. The results are also in agreement with the observations made by Kelly (1991) who noted that males in Zambia show consistent superior performance in Grade 12 mathematics.

Grade 12 science.

Grade 12 results show the number of students in each performance category (i.e. distinction, merit, credit, pass and failure) for the following subjects; chemistry, biology, and physics. Male performance was superior in all the three subjects. Males dominated the distinction, merit, and credit categories in these subjects. Biology was the most popular science subject.

In general, the results obtained all conform to the observation made by the IEA (1988), which noted that gender differences are quite large in the 12th grade in all science subjects. Randawa's observations that gender differences in science and mathematics tend to be magnified at higher levels of education were also upheld. These results differ from those obtained by Rosier and Long (1991) who observed that females performed just as well and often better than males in high school biology.

Question 4.

Do locality differences in achievement scores exist at Grades 7 and 9?

Grades 7 and 9 English language: Locality.

ANOVA results show that locality was significant for Grade 7 but not Grade 9, i.e., the fact that a student was attending school in an urban or rural area affected performance in English language. This was particularly true of females where urban females did considerably better than rural females.

These results do not entirely agree with those of Randawa and Hunt (1987) who observed that urban students showed superiority in vocabulary. Only interaction effects for gender and locality were significant for Grade 7 in comprehension skills but performance in these skills are not specifically mentioned by Randawa. Rural students in this study did not outperform urban students in writing and reading skills as reported by Randawa and Hunt.

The observation by Opper (1977) on the adverse effects of malnutrition on school performance especially in rural schools did not seem to be material in this study. Rural male students performed very well in comparison to urban males and urban females.

Grade 7 and 9 mathematics: Locality.

The results following the analysis of variance for Grades 7 and 9 in mathematics show that interaction effects of locality and gender were significant in both cases. On examining performance in Grade 7 mathematics by the skills of Computing, Geometry, and Problem solving, locality was only significant in computations in which urban students performed better than rural student.

The only relevant studies cited for this level which studied performance by locality in mathematics was by Randawa and Hunt (1987). The results obtained in this study do not agree with the observations made by Randawa and Hunt in so far as urban students showing superior performance in mathematics problem settings. The results of this study also differ with Randawa and Hunt's observation that performance in mathematics is independent of urban-rural residence because significant interactions and locality were reported in mathematics at both Grades 7 and 9.

Grade 7 and 9 science : Locality.

The results show that locality was significant for science at Grade 7 but not at Grade 9. When the Grade 7 scores were analyzed according to the skills of information and reasoning, significant locality results were in reasoning skills only. Urban students did better than rural students in this category of skills.

The observations by Mwamwenda (1991) that urban students perform better than rural students in some cognitive activities some of which are scientific in nature are difficult to justify because it is only the female students who seem to have been affected by locality. Group contrasts shows that locality differences between male groups were non significant at Grade 7. Performance at Grade 9 showed non significant locality differences.

Question 5

Do gender and Locality differences exist at Grade 7 in school attitude scores?

Female students obtained mean scores that were all below those of males. The gender differences were particularly large in scale B (Self concept-performance based) and scale E (instructional mastery).

The relatively low scores for female students means that they were relatively less motivated for schooling and had lower self concept. They seem to have lower expectations for success. Females also reported that they were largely unable to control their level of performance in school subjects. Lastly, females felt they were not as competent academically as their male counterparts.

The relatively higher scores for males in scales A, B, C, D, and E, means that they were more motivated for schooling, had higher self concept (B & C), and felt that they could control their academic performance. This group also felt academically more competent.

These results generally support the observations made by Haggerty (1991) and Oliver and Simpson (1990) who noted that female poor performance in mathematics and science was adversely affected by poor attitude such as lower self-concept and lack of motivation. Females not only had lower attitude scores, they had lower scores in mathematics and science especially at high school level.

Rural students had scores that were all below their urban counter parts in every scale. The largest locality differences were also in self concept-performance based and instructional mastery. The size of the differences in scale E (instructional mastery) may mean that rural students particularly felt academically incompetent.

Urban students had superior scores in every scale. Urban students were better motivated for schooling, had higher self concept and felt more in control of their academic achievement. This group also felt academically more competent.

There was no reference in the literature reviewed linking locality with school attitude. In this study however, rural students were outperformed in both school attitude scores and in mathematics.

Question 6

Do gender differences exist in School Enrollment Patterns? Enrollments are described by Grade in the following paragraphs.

Grade 7 enrollment

No major examination is given before Grade 7 in Zambia. The number of male and female students at this level differed only by a relatively small margin. This difference in favor of males is due to higher attrition among females due to various causes not related to examinations.

Up to this level, both grade and subject enrollment is not directly related to the effects caused by examinations and subject choices. Differences in achievement cannot be attributed to subject choices as there were no subject choices except for local languages which were in any case not taken into account during the grade promotion selection process.

Grade 10 Enrollment

At Grade 9, there were more male students than females, primarily because more male students passed the Grade 9 examination. Just like in Grade 7, the cut-off point for promoting females at Grade 9 was much lower than that for males.

There were three compulsory subjects at Grade 9. These were English language, mathematics and science. In order to qualify for a full certificate, students were expected to pass in at least eight subjects including the three that were compulsory. Because students had virtually no subject choices at Grade 8, performance at Grade 9 could not have been affected by subject choices at Grade 8.

Grade 12 Enrollment

Grade 12 offered the largest subject selection or choice for students. Students were required to take, among others, English language, mathematics, science, and four other. The majority of students took English language, mathematics, a science subject such as biology, physics or chemistry, history, geography, and either commerce or an additional subject from those subjects already mentioned.

The choice of subjects at Grade 12 was mostly dictated by performance at Grade 9 in the individual subjects e.g., a person who did very well in science at Grade 9 was much more likely to take chemistry and physics as separate subjects. A person who was good at English language was much more likely to take English literature; and a person who was very good at mathematics was much more likely to take additional mathematics. Poor performance in science could mean taking only biology or general science which were regarded as less difficult. Inevitably, these choices taken at Grade 12 determined who went to the School of Natural Sciences at the University of Zambia or other mathematics based colleges where students are required to take physics and chemistry as separate courses.

Grade 12 data on enrollment patterns shows that there are more males than females at higher levels of the school system. Male enrollment in physics, chemistry, and biology was much higher than that for females. Performance by females in science and mathematics subjects was much poorer than that of males. The higher percentage of males at higher levels of the school system in comparison to females is contrary to what occurs in North America as reported by Halpern (1986) and Maccoby and Jacklin (1974) where more females remain in school. The Grade 12 subject enrollment figures for this study are consistent with Maccoby and Jacklin (1974) observations who noted that there generally more males than females enroll in science and mathematics courses in high schools.

SUMMARY

In summary, the findings in this study have shown that no significant gender differences exist in English at both Grade 7 and 9. This means that at both levels (Grades 7 and 9), both genders performed about the same in English Language. When the scores are analyzed according to skill, males show superior performance only in reading and writing skills. There are locality differences in favor of the urban students in Grade 7 English and science. Females performed slightly better than males in English at Grade 12.

In mathematics, significant differences in favor of males were present throughout the school system. Interactions were significant in mathematics at Grade 7 and 9. At Grade 12, the top categories of distinction and merit were dominated by males demonstrating their superior performance in this subject. At Grade 12 the majority of students from both genders took biology. Physics and chemistry were entered by a smaller number of students from both genders. There were much fewer females enrolled in physics and chemistry. Males performed much better than females in general at Grades 7, 9 and 12 in mathematics.

The females as a group had a less positive school attitude as evidenced by lower school attitude scores. Similarly, rural students had lower school attitude scores and felt less motivated for schooling.

With regard to enrollment patterns, it was noted that there were more males than females through out the school system, especially in higher grades. The progression rates for females at both Grade 7 and 9 were smaller than those for males. It was also noted that cut-off points for females were lower at both levels. This allowed more females with lower scores than males to get promoted to higher grades.

All subjects at Grade 7 were compulsory. At Grade 9, the choice of subjects was wider than in Grade 7 but was still very limited. Grade 12 offered the largest number of subjects. The number of subjects taken before Grade 10 did not seem to affect performance in higher grades due to limited choice of subjects before Grade 10. Performance at Grade 9 determined which subject a student was allowed to take in high school which ultimately determined career choices.

Limitation of the Study

The study was limited by the stratified nature of the sample. Since direct random sampling of students from across the country was not possible, the next most effective way to get a representative sample was to select schools by random sampling from each locality (stratified sampling) and then select students by the same method from each school and class. This was required in order to make it possible to have the same sample for the SAM administration.

Due to the selection process which takes place after Grade 7 and 9, students who go on to Grade 8 and beyond are highly talented and do not represent the average Zambian students. The two genders had different progression rates.

The School Attitude Measure by itself is rather limited in the kind of information it provides to explain the causes of poor performance by females. Other factors such as parental, peer, and teacher influence also play an important role but were not studied. The SAM measure was however found to have moderate to high concurrent validity with these and other relevant factors (Dolan, 1983). Because of this, it was considered an appropriate measure.

Being partly a study based on recorded data, the researcher had no control over extraneous variables that affected the initial compilation of data by the Ministry of Education e.g., the researcher had no control over testing conditions, quality of marking, moderation (alteration of marks) and subject grading as these had already been done for Grades 9 and 12.

This study was restricted to studying Grades 7, 9 and 12 because it is at these levels that scores for previous nationwide external examinations were available.

Implications of the study

The findings of this study will make a contribution to understanding the nature and extent of gender and locality differences in academic achievement in Zambia especially in English, mathematics and science.

The very poor performance shown by females in mathematics and science is evidence that females have a problem in these subjects which need to be addressed. It is also worth noting that females had lower attitude scores. The lower number of females enrolled at higher grades in general and in chemistry and physics in particular, means that females are still restricted in career choices which would require knowledge of these subjects especially at higher levels.

This study will add to other studies that show that gender differences are still present in some countries including Zambia. Gender differences often occur throughout the school systems but especially in higher institutions of learning.

This study will also provide a basis for cross-cultural comparisons in studies related to gender differences in academic achievement and the effects of locality, school attitude, and enrollment patterns on achievement in schools.

Suggestions for further research.

There is need to asses general ability levels of all students prior to measuring their academic achievement as the two are closely related. Aptitude affects a student's academic ability.

The school attitude measure or similar school attitude scales should be administered at all levels of the school system or at the beginning, middle and end of school, so as to provide more accurate measure of the change in school attitude along side academic achievement and age.

There is need to observe directly the attitudes and characteristics of students, parents, peers and teachers so as to establish a clearer link between attitude factors as they relate to the Zambian social and cultural practices.

The extremely low scores in mathematics and obtained by females merits separate research. The study should focus on the skills problematic to female students or any group that appears disadvantaged.

There should be more validity and reliability studies on Zambian external tests. A study on different learning styles of both genders seems appropriate.

If this study is repeated, a hierarchical ANOVA is suggested. This approach could show how class, school, locality each contribute to the variability of achievement.

A study on gender differences in academic achievement is important, especially in Zambia, because of the small number of women who attend school at higher levels. This happens in spite of lower cut off points which women have to pass for both certification and grade promotion purposes. A study of this nature in Zambia should always take into account locality differences because of vastly different social and cultural experiences by rural and urban students.

Proposed course of action to improve performance by females in rural areas.

The following major observations were made in this study:

1. Females from urban schools performed almost as well as males from both urban and rural schools in all the three subjects studied at both Grades 7 and 9.
2. Male students from rural areas performed just as well as male students from urban areas in all the three subjects studied at Grades 7 and 9.
3. Females from rural schools performed much worse than female students in urban schools and both male groups at both Grades 7 and 9.
4. Females in general were less confident about their ability to to do well in school than their male counterparts. Females from the rural areas showed the least confidence.
5. There was a higher drop out rate among females i.e. there were fewer females who proceeded to higher grades.
6. Females who got promoted to higher grades had lower scores in comparison to males. It is noted that this is not a good solution. A good solution would involve taking steps to improve the actual performance of these students. Promoting students with lower does not help improve the capability of those promoted.

It is being suggested that steps be taken to improve academic performance by female students, especially in rural schools.

1. The Ministry of Education, as a first step, should provide funds to implement the suggestions as a demonstration of commitment.
2. The Ministry of Education stands a good chance of changing school attitudes when students are still very young and therefore special attention must be paid to students in primary schools.
3. Teachers have a very important role in shaping student attitude towards school. The syllabuses for teacher training colleges, especially those used in the training of primary school teachers must incorporate the need to strongly encourage their female students to realize their full potential in all the subjects but more especially in mathematics and science.
4. Teachers that are already trained should be have new directives issued to them so that they make a stronger effort in encouraging females not only to perform well in science and mathematics, but also to think of following careers in these fields.
5. Teaching syllabuses for schools should have a section that deals with school attitude. Improving school attitude towards science and mathematics should be one of the teaching objectives. The Ministry of Education should monitor both changes in performance and school attitude especially rural females.

6. Female role models should be encouraged to speak to female students as a way of encouging them to aim higher in their academic goals.
7. Changing school attitudes is likely to be a slow process so long term commitment is required.

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