A STUDY OF MATHEMATICS HOMEWORK PRACTICES IN SELECTED SECONDARY SCHOOLS IN KENYA

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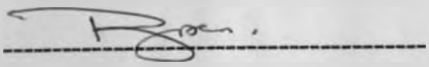
A Thesis submitted in fulfilment for the degree of
Doctor of Philosophy (Ph.D.) in the University of Nairobi.

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.



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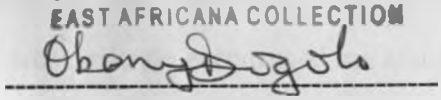

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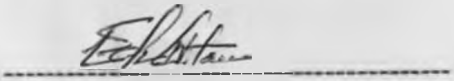

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DEDICATION

This work is dedicated to my father,

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For his enduring encouragement

and to

Mr J. Gachoho (Gaichanjiru Sec Sch.) and Mr E. Dearn (Nakuru High Sch.) mathematics teachers, who patiently encouraged me and other students through Mathematics difficulties, because they believed it was their duty to do so.

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Abstract

Homework is a common phenomenon in many Kenyan secondary schools, defined as work that is assigned by the class teacher to be done outside the class time. The poor performance of mathematics is a concern to many. (c.f . Daily Nation 1998, February 25:6 and Standard 1992,June 9:8). This is despite the fact that mathematics teaching in Kenya is given almost five hours or 11.1 % of instructional time in a week.

Homework is part of teacher's strategies (Stern, 1995) which has an impact on learning outcomes in mathematics. Yet there has not been so much research on what is done, how it is done and how homework can be planned to meet the needs of different pupils. This dissertation is an attempt at a more detailed study to highlight the situation in Kenya.

The study had the following objectives:

1. Identify the nature of mathematics homework given to secondary school students in Kenya
2. Investigate teachers' perceptions on the value of homework
3 Find out the opinions of secondary school students regarding homework
4. Investigate the relationship between selected demographic, psychological and school variables in relation to homework and achievement in mathematics.

Being a basic study in homework, this research was designed as a cross sectional survey. It collated original information on this important area and perhaps may pave

way for other research designs, (Babie,1986). Strang (1975) also advocated that further studies on homework first observe, identify and describe behaviours and teaching related to homework.

A multistage random sample of 1783 secondary school students and 147 mathematics teachers was selected in four provinces of Kenya namely; Central, Coast, Nairobi and Western. The students were selected from Form 2 and Form 4 classes in the secondary schools. Mathematics teachers of Form 2 and Form 4 classes were selected from the schools selected. Questionnaires and achievement tests were the main instruments used to collect the data for the study. Interviews and classroom observation were also used to provide supplementary information, which is used to explain and validate the data obtained from the main instruments.

Descriptive statistics (Percentages, frequencies, means,) and inferential statistics (analysis of variance, correlation) techniques were used to summarize the relationships in the data. The SPSS computer program was used in the analysis.

From the study, it have emerged homework is considered an important activity by both students and teachers. Many students preferred less homework to be able to have time for their own revision in mathematics and other subjects.

1. The teaching of mathematics, as regards homework, did not seem to have a sound theoretical base and students express dissatisfaction with it. Homework

was given almost daily in all schools, was the same for all students in the class. It was almost always given at the end of the lesson, sourced from the class text, and was drill on the content covered in the lesson.

2. Teachers and student differed on their perceptions of on the negative aspects of mathematics homework, and reasons for non-completion. Perceived difficulty of mathematics and the quantity were the most important reasons for non-completion of homework. Form2 and Form 4 classes differed on their perception of mathematics homework difficulty. There was no difference between boys on this variable.
3. Achievement in mathematics was negatively related to the number of hours a student put into mathematics homework/study, with the weaker students taking more time on homework. Time spent on homework by both boys and girls was not significantly different. There was a difference, though when students were stratified by class and residence.
4. Low achieving students tended to have lower attitude scores on homework than higher achieving ones. Boys and girls were found to differ on their attitudes to homework, with boys slightly ahead. Boarders also had significantly higher attitude mean scores than day scholars. Students' self-rating on ability in mathematics was significantly related to their attitude to homework.
5. Most students preferred to do their mathematics homework in the morning with more, but with more day scholars than boarders, and more boys than girls preferring the evening to the morning. Day scholars seemed to be disadvantaged

with respect to study facilities (books, study desks, lighting), and on the help they could get from friends on difficult homework.

The study looked at the bigger picture in homework, but is consequently limited in its description of the fine detail that would enable the researcher to make more definite statements on the relationship between homework and achievement in mathematics. Recommendations for action include providing for disadvantaged students through community centres and addressing the disparity between teacher and students perception arising from mathematics homework. Recommendations for further research are outlined in the thesis.

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LIST OF ABBREVIATIONS AND ACCRONYMS

ANOVA	Analysis of variance
CAT	Continuos Assessment Test
DEO	District Education Officer
HOD	Head of Department
HWTIME	Homework Time
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KNEC	Kenya National Examination Council
MOE	Ministry of Education
PDE	Provincial Director Education
RETIMP	Relative Time on (mathematics) Practice
SMASSE	Strengthening of Mathematics and Science in Secondary Education

CHAPTER 1

GENERAL INTRODUCTION

1.0 Introduction

In this first chapter, a background showing a rationale for the choice of the study is given. This chapter also describes the gap that this study hoped to fill, the objectives and hypotheses of the study, purpose and significance of the study, and limitations of this study.

1.1 Background to the study

In almost every country of the world, education is now acknowledged to be one important means of promoting economic, social and national development, Fagerlind & Saha (1983), Malyamkono et al. (1982). Education is also considered to be one sure way for individual self-development including upward career mobility and economic well being, Weisbrod (1970), Republic of Kenya (1964). With the decreasing opportunities for university entrance and employment, many people are concerned with students' performance in national examinations. In Kenya, only about 0.5 % of those entering Standard One ever make it to university (Republic of Kenya 1984), making the Kenyan school system very competitive.

This may also be observed from the high number of newspaper articles commenting on performance once the Kenya Certificate of Primary Education (KCPE) and Kenya Certificate of Secondary Education (KCSE) results are announced around January and March respectively of each year.

To cushion their children from failure, many parents and schools encourage private tuition (coaching) for their pupils in preparation for national examinations. For instance, Kapiyo (1980) in a study of mathematical achievement among standard Seven pupils reported that many pupils in Kisumu Municipality schools were attending evening coaching in English and mathematics. Similarly the 'Daily Nation' (1991, October 19:20) had this to say on coaching:

> The Kenyan system of education is heavily skewed towards examination success and it has been embedded in the minds of students, their parents and teachers that extra tuition is necessary to insure against probable failure. Contrary to the belief that coaching is only rampant in urban schools, it is in fact common in rural areas as well.

A preliminary search for articles in the local daily newspapers in the 1980s and 1990s revealed many articles on private tuition but few on homework. This may suggest that parents, teachers and students long for their children's success in examinations, and one important route to such success is through tuition. Since all are aware of homework, it would also imply that homework is not taken as seriously as coaching or that the public is satisfied with the way homework is conducted toward success, or even that they don't care about its possible contribution. This latter position is untenable in view of the foregoing evidence.

According to the International Dictionary of Education (Page, 1979:164), homework is school -work done at home. For clarity, it may be added that it is work assigned by or in conjunction with a teacher in class to be done after

lesson time, no matter where it is done. It may be done within the school, at home, or elsewhere. Some may refer to it as assignment, perhaps to emphasise that it is given by the teacher, and to remove the association with the home for boarding schools. Almost every pupil in Kenya is familiar with homework, being an old instructional technique.

Most mathematics textbooks contain many exercises after every topic which students are expected to work on. Leder and Gunstone (1990:110) argue that "the pages of graded examples found in many textbooks in use today are reminiscent of Thorndike's (1922, 1924) own graded drill and practice examples". The assumption is that students would attempt/or do the problems after the explanations, and in so doing learn mathematics.

In China it is reported that parents resisted an innovative 'homework -free ' program developed by educational experts from the East Normal University fearing that their children might not make it to high school and university (Curriculum Review, 1995, January: 4). In Japan, Shiba (1986) reports a successful private tuition programme, the Kumon Institute of Education that has been used successfully to uplift the performance of students especially in mathematics and English. The programme is worth mentioning because essentially it manages students' progress through worksheet tasks, that a teacher assigns and marks, an equivalent of homework.

Mathematics is considered important for scientific and technological development (Travers & Westbury 1989:33) and consequently are compulsory subjects in the Kenya secondary school curriculum, Eshiwani (1981:1). The first IEA study of mathematics noted that:

> In recent years a growing recognition of the importance of mathematics has led to a widespread concern in many societies about the output of mathematics learning that emerges from educational systems. Mathematics is, or is seen to be, of such importance that the quality and quantity has become...a social issue. Travers and Westbury (1989 167)

Locally, scholars have also lauded the place of mathematics in science and technology as being "at the centre of socio-numeric transactionism and technological development (Gunga, 1998:1) and as " the foundation stone of Scientific and Technological education." (Kimani, 1991). The relationship between education, science and mathematics is succinctly summarised by Kuku (1990) –in a discussion on the role of mathematics sciences in African development:

> The social and economic development of any country or continent could be measured in terms of its development in science and technology. Since we cannot have technology without science and neither can we have science without mathematics, it is clear the social and economic development of a country or continent ultimately depends on its development in the mathematical sciences

Hussen (1967 243) similarly reported that in all countries, the number of scientists and technologists produced at the various levels were inadequate because students found mathematics dull or difficult or both. Being such an important subject to Science and Technology, Mathematics is a compulsory subject to all pupils in all countries in the world. Three international studies on the teaching and learning of Mathematics were based on such considerations. (Hussen, 1967), (Travers & Westbury 1989). Travers and Westbury (1989:1) had this to say about mathematics:

> Through out the world, mathematics occupies a central place in the school curriculum In most school systems between 12 and 15 percent of student time is devoted to mathematics... In view of the importance of mathematics in society and in the schools, the efficacy of mathematics teaching and learning demands continued and sustained scrutiny.

In Kenya, the Mathematics syllabus in schools has been changed thrice in the last 40 years. At first there was the traditional Mathematics, then came the new/modern, and lastly the appropriate mathematics since 1981 to the present. Many comments were recorded in the local press on modern mathematics, thus confirming that Mathematics is a social concern. In Britain, there was the Cockcroft committee which was instituted to study Mathematics teaching and learning in schools (Cockroft 1982). In the USA, Kline (1980) mentions several groups that campaigned for and helped shape the Mathematics curriculum .

Despite the importance accorded to Mathematics, the problem of poor performance is worldwide. For example, Holmes (1983) reported low

performance (with many failing) in Mathematics in Israel. In explaining some of the reasons which prompted the introduction of modern (new) Mathematics Kline (1980: 8) reports that " there was general agreement in the 1950's and even before that the teaching of mathematics had been unsuccessful. Student grades in mathematics were far lower than in other subjects." Nichter (1984) in a study for the UNESCO science improvement project in Africa reported a shortage of Science and Mathematics teachers. This in turn was caused by poor results in these subjects at the school level. The Gachathi Report in Kenya (Republic of Kenya, 1976:67) reported a similar problem.

Table 1.1 below summarises the mean scores for students in KCSE Mathematics from 1993 to 2000 and shows how serious the failure rate is. For example one notes that the Mean mark for a Mathematics paper(s) has always been below 20% over the years shown in the following table 1.1.

Table 1.1

Mean marks of KCSE mathematics since 1993

paper	out of	1993	1994	1995	1996	1997	1998	1999	2000
paper 1	100	12.5	13.5	13.2	17.1	17.4	19.6	13.5	17.5
paper 2	100	17.0	9.3	13.2	19.0	15.4	15.6	11.0	15.1
average	100	14.5	11.4	13.2	18.1	16.3	17.5	12.2	16.6

Source: KNEC reports

Many people in Kenya are concerned with the performance in Mathematics and English which are done poorly year in year out. In reacting to the announcement of the KCSE 1997 results, an editorial of the Daily Nation (1998, February 25:6) commented that:

> ...also worth noting in the results is the poor performance in mathematics ... a trend that has continued for some time now... This is a serious indictment of a nation whose eyes are focussed on industrial take-off in the first quarter of the next century.

Similarly an editorial of the 'Standard'- estimated to be the second largest readership daily in Kenya - (1992, June 9:8) lamented the poor performance in Mathematics especially in secondary schools and at the polytechnics. They were concerned that poor performance in mathematics lowers students overall performance.

In 1996, there was a serious exchange of views from people all over Kenya in reaction to an article, the "Mathematics failure debacle". (Muya, 1996: October 12) in which he wrote that:

> ...in KCPE where more than 30 per cent of candidates get grade A and B, more than half of the standard eight candidates get grade D+ and above. However most pupils become mathematically incompetent when they join secondary school. In 1995 KCSE only about 5.25 per cent of the 140,000 candidates scored B- and above, only 18.5 per cent of the candidates managed a grade D+ and above.

(Note: In the grading system, grade D+ is the pass mark.).

Several suggestions were put forward as to why there was a problem. Primary school teachers blamed secondary school teacher for laxity, secondary school teachers blamed primary teachers for teaching the students only to get the answer without working methodically. Bull (1996, November 2), explained that "no subject depends on the teacher like mathematics. To those who 'cannot' do Mathematics their inability can almost certainly be traced to a poor teacher" while Wahome (1996, November 6) explained that the methods and tools are critical saying that mathematics "lessons are inevitably a monotonous dreary experience of books, chalk and of course the cane. This erodes the students interest. . . . primary school teachers effectively use oranges to teach fractions, balls for spheres and even fingers and toes to aid enumeration". Kimamo (1996,October 28), was of the opinion that "teachers can boost the students' morale by dispelling the latter's feeling [that] they are a special or exceptional breed of people as they are able to teach Mathematics".

The editor (Daily Nation 1996, October 14) commented that "it certainly doesn't make sense for the Ministry of Education to continue to keep staff on the payroll to teach a subject in which the majority fail". This may be the feeling of a number of people, if the editorial of a wide circulation daily newspaper be the voice of some majority in a country. Tsuma (1996, October 19), suggested that "the problem of poor performance in Mathematics is serious enough to warrant mounting a national seminar similar to the one organised by the Commission for Higher Education (CHE) on science education in 1990."

Similarly commenting on the performance of the 1990 KCSE examination, the KNEC reported that candidates seem to lack basic knowledge of Mathematics and even to have forgotten what they learned in primary school. They suggested that this problem should be dealt with through remedial teaching.

One wonders why Mathematics (and English) which are given so much time on the timetable are the least well performed in Kenya national examinations. One would expect that, other things being equal, time allocated to a subject would be roughly related to achievement in the subject. Stallings & Kaskowitz (1974), Psacharopoulos (1986). Other research, however, seems to show no significant relationship perhaps because allocated time is only a rough indicator of time actually spent learning, Roseshine & Berliner (1978). Coulter (1979) argues that out of class learning especially homework is an important factor not considered in such time-achievement studies.

At the secondary school level of the current 8-4-4 system, there are seven and six instructional periods per week for mathematics and English respectively. This works to about 15% and 13% of the school time. It is thought that these two subjects also receive the largest amounts of homework and tuition. Could it be that students are not satisfied with the use of time in these subjects for example, too much homework or have they formed negative attitudes towards these subjects as a result of the homework practices and teaching?

KNEC (1995:83) reports an unfortunate state of affairs in mathematics that:

> The performance [of mathematics in KCSE 1993/1994] indicates that some candidates may have 'dropped' mathematics after may be two years in secondary school...there is no other reason than lack of interest in the subject that can make them 'drop' the subject. Lack of interest could be due to the way the subject is taught. We therefore request teachers to devise ways of making maths interesting to their students.

Dropping Mathematics may be unfortunate considering the fact that Mathematics is a compulsory subject which is required in many post-secondary courses and in other spheres of life in an increasingly technological world. Dropping Mathematics by Form 2 certainly narrows down students' choice, but without the students' full awareness of the consequences of such actions.

For example a look at the KCSE enrolments between 1997 and 2000 for Physics (more associated with Mathematics) showed a 21.17 % increase as compared to 46.8 % in Biology (less associated with mathematics). Students who avoid Mathematical courses also tend to avoid courses that need Mathematics, (Sells, 1976), while students who choose to study Mathematics are more likely to pursue science courses, (Thomas, 1984).

Whereas there could be other reasons for poor performance in Mathematics, motivation with the right attitude is central to the learning of mathematics or any other subject, for that matter. But it is so much more important in mathematics because the subject requires students to deliberately and logically

apply themselves to solve puzzles using known rules, [Gunga (1998:17)]. Mutunga and Breakell (1987:221) assert that if mathematics students are dissatisfied or discouraged, they may exhibit unfortunate behaviour or they may refuse to exert any reasonable effort to the task at hand.

Sears (1966:22) similarly contends that "in any thoughtful attack upon the improvement of education for pupils who must live in this modern world, one is immediately struck by the fundamental role of attitudes and motivations in the learning process". Good and Brophy (1987:310) suggest that for students to be motivated to learn they need a supportive environment, appropriate level of task difficulty and meaningful objectives and:

> ...not continued practice on skills that have already been mastered ....and working on tasks that are assigned merely to fill time rather than achieve meaningful learning objectives.

Appropriate level of task difficulty is defined as " when students are clear enough about what to do and how to do it so that they achieve high levels of success if they apply reasonable effort." One anticipates a motivation problem when the student is asked to do Mathematics homework tasks that are too difficult or unclear.

As stated above, pupils could do poorly in mathematics because of their low motivation that results from poor teaching methods. Homework is one aspect of teaching mathematics, being one of the teacher's strategies (Stern, 1995).

Holder & Mitson (1974:ix) caution that " that teaching produces learning, and that learning is a result of teaching are the twin fallacies on which traditional schools are based, in many school schools a lot of teaching, but not learning takes place." This would seem to summarise the situation in mathematics well: students are taught Mathematics almost every day in the week, yet they don't seem to learn, if the Mathematics reports of the KNEC are anything to go by. KNEC (2000) argues that poor performance in a subject indicates areas of the syllabus not covered or poorly covered, and suggests how such areas could be better managed or taught better. Though there is plenty of research on factors that contribute to success in mathematics none looks at how homework is organised in Kenya or how it contributes to failure or success in Mathematics.

Homework is a variable that teachers themselves can alter to improve learning in mathematics. Mathematics homework can serve as feedback to the student and teacher in the learning of mathematics. Have the skills learnt today been mastered? Are the students ready to move on to the next topic? But it can also be used negatively, perhaps unwittingly, to convince the student that they are not good at all in Mathematics.

Oliveira-Lima (1983) considers tests and examinations as " a necessary tool for the teachers to control their classes with, in the absence of better teaching methods of motivation. If they didn't have the power to fail people, the great majority of teachers would be unable to practise their profession". Perhaps homework in mathematics offers the teachers such a daily examination to keep

in control or even to while away time to cover for lack of planning? Klieband, (1995) similarly asserts that " Practice and drill [homework?]... persist not because they have specific pedagogical sanction but because they are proven instruments of control". To motivate students to do homework, Ashworth (1981) advocates that teachers must select homework carefully to ensure that students can do most or all the problems given. Otherwise, it will be the usual state of affairs that "often the homework leads to frustration and annoyance on the part of the child and the parent as they watch the child prove to himself he is no good and doesn't know how to do maths." Ashworth (1981:71).

It seems that in many good performing schools in the KCSE, a high degree of efficiency is built into the instructional system reducing the need for extra tuition. Muya (1991, February 23:19) reported Griffins, the Director of the Starehe Boys Centre (school) as saying that students start preparing for KCSE in Form 1 and that without good management of time there cannot be success in these examinations. Sr. Claudia of the Precious Blood school (a leading girls school in Kenya) was quoted in the 'Daily Nation' saying that "the 8-4-4 curriculum is quite demanding and both teachers and pupils and teachers do extra work to cover the syllabi", ('Daily Nation' 1991, February 23). In outlining her school's position, another Principal of the same school said that "our foremost goal is not academic achievement but the integrity and well being of the whole person. As a consequence good results may follow." (Vogel,1998). Maneno, the then Alliance School (another leading National school) principal had similar sentiments when he said

> It is not only the quality of students selected in form one that matter but also what actually happens to the student in the four years he is preparing for his 'O levels. This is what matters. If nothing positive and constructive happens, the student will certainly do poorly. (Weekly Review:1984, March 2)

Chege (1992 July 4:14) argues that though Catholic Schools in New York have larger classes, less professional teachers, more limited resources and less expenditure per student, students perform well. Although there could be other explanations for such performance, he underlines the contribution of homework saying that:

> Catholic schools give more homework to pupils, especially those that are disadvantaged in one way or another.... Catholic Schools in the United States Perform better in English and Maths and that in intellectual development, they significantly outpace public schools.

OFSTED (1995:2) in their report on homework concluded that homework has the potential to raise standards, extend the curriculum coverage, allow more effective use of class time and improve students' study skills and attitudes to learning. ILEA (1984) also called the Hargreaves Report (1984) similarly emphasized the importance of homework in cutting down instructional time in British secondary schools.

Among many instructional methods books skimmed in local libraries, the author found only a few that gave more than a cursory treatment - about a paragraph or

two - of homework/ assignments. Among these are Arends (1981:70 -94), Bell (1978; 391-395), Patel and Ayot, (1987:110- 117).

Stern (1995: 47) had a similar concern over lack of emphasis on homework in Britain and wrote:

> Practically every course I have been on has either ignored homework altogether, or at best, just mentioned it. With homework I really do think we differentiate or die - either differentiate or set mindless tasks or set no homework...much less time seems to be spent justifying, planning for, and supporting homework, than is spent on classwork. There hasn't been so much research on what is done, how it is done, and how homework (like classwork) can be planned to meet the needs of different pupils and to allow all pupils equal opportunities.

Grambs and Carr (1979:319) state that homework must be genuinely aimed at learning otherwise it would be busywork, which is destructive for it destroys students' confidence in the teacher's values. Where homework is used effectively it is assigned when needed and not as part of a daily or weekly ritual. The amount of homework should be controlled so that it does not make excessive demands on the students' time, Butler (1969). One therefore wonders whether teachers in secondary schools follow accepted learning principles in their organisation and management of Mathematics homework, despite lack of guidance on homework from common books.

Some research has been done in the USA and Britain on homework but in Kenya only two studies were found that touched on the issue of homework. (Kibanza, 1980), Eshiwani (1983). This latter study by Eshiwani, (1983) reported that:

> over 60 per cent of the schools had no formal prep or homework given to pupils. Although prep appears on the timetables, pupils are left to do what they like. Headmasters do not check on their teachers to make sure they set assignments for prep/ homework. In other words, prep/ homework is not taken seriously either by pupils or by teachers in most schools in western Kenya. (p.27)

It should be worthwhile to probe Mathematics homework in Kenya to find out how it works and how it can be best organised to improve students' performance in Mathematics. It seems possible that good organisation of homework could obviate the need for private tuition, and thus help raise the performance in Mathematics of all or most students whatever their social economic status. Eshiwani (1983:27) argued that homework should be taken seriously as an integral part of the teaching /learning process saying "Here is a variable that is virtually costless in terms of money but which seems to provide a high return in terms of school achievement."

1.2 Statement of the problem

The poor performance of mathematics is a concern to many. (c.f . Daily Nation 1998, February 25:6 and Standard 1992,June 9:8). Homework is part of

teacher's strategies,(Stern,1995), and it is one important way through which learning time can be extended, (Arends, 1991). The Hargreaves Report (1984) in Britain noted that in secondary education homework can contribute the equivalent of at least 20% saving in full time study and that poor homework policies contribute to enlarging the achievement gap between higher and lower achievers. Through homework the student can learn to be responsible for "responsibility is predicated by [sic] autonomy ... there is no where in mathematics is the learner more autonomous than during homework", (Spandano, 1996).

Although homework is an important area of concern to parents, pupils and teachers, it has not been adequately addressed in Kenya. There has not been so much research on what is done, how it is done or how homework can be planned to meet the needs of different pupils in mathematics.

One study by Eshiwani (1983) was counted, but even this one, touched on homework incidentally. It looked at homework as one of the variables that contribute to poor performance among primary and secondary school pupils in Western Kenya. (Eshiwani, 1983). The study did not distinguish between prep and homework. Although the two aspects are related, this study will distinguish between them and emphasise on homework because in it there is an implication for partnership between the teacher and the student. Prep time is preparation time, time when the students are expected to do their own personal study and complete homework in the various subjects. During prep students may choose

to do homework in mathematics or some other activity. A more focused study is therefore needed to highlight the situation in Kenya.

In Kenya the secondary school student has about as many hours to learn outside class (4 p.m. to 10 p.m.) as they do in class (8am -4pm). This means that a student can put as many hours into his or her own study as with teaching. Although all schools have the same time assigned for learning Mathematics, (allocated time) the time actually spent learning Mathematics (engaged time), will differ from school to school depending on the efficiency of the instructional process.

Learning time in which students are actively engaged and experiencing a high rate of success (at least 75%) – called Academic Learning Time (ALT) is the most highly correlated with achievements, (Denham & Liberman, 1980). Yet teachers could be taught to change the Academic learning time of their students for the better in twelve hours. (Berliner, 1978). Caillods and Postlethwaite (1989: 188) recommend that "homework is highly associated with increased achievement and it is important that it takes place in greater amounts as pupils ascend the school system".

One equitable way to extend academic learning time in mathematics is through good homework management (Arends, 1985:83). Homework is well managed when students work on homework and teachers are willing to supervise it to help individual students to achieve higher in mathematics. Hamblin (1981)

advocates that "consistent training in homework methods is necessary if negative attitudes are not to develop ... pupils not only under-function in school but also in homework" Butler (1969:373) warns that homework is inefficient for the time consumed is often disproportionate to the value gained, and that it often results in misconceptions and the making of so many errors that much time is spent in the next session of the class correcting errors made at home, errors that could have been prevented by sufficient preparation in class.

In talking about rights and duties of a pupil in the school, Jensen & walker (1989:158) propose that there be a statute on homework spelling out the obligation to do homework, homework period on the time table, overall load of homework, spreading of homework tasks, and the possibility of being exempted from homework as a way of giving leave. Is there such planning for homework towards a culture that values homework as an important school activity? Are Kenyan secondary school students adequately engaged and do they experience high rates of success in after class mathematics activities especially through homework? Could the homework itself be the problem in learning mathematics? How do secondary school teachers and students in Kenya view homework and how does the homework focus in schools affect their performance in mathematics? Do secondary school teachers put the necessary effort to guide students to show their working method or do they encourage the system of the 'answer only' used in the primary school? After all secondary school Mathematics teachers have a whole four years to inculcate desired values

in the more mature students. The researcher has attempted to answer some of these questions along the objectives and hypotheses stated below.

1.3 Research Questions

The following are questions this study attempted to answer:

1. What is the nature and context of mathematics homework given to secondary school students in Kenya?
2. How do students and teachers perceive such homework?
3. What are mathematics teachers perceptions of homework
4. Is there a relationship between selected variables related to homework in mathematics and achievement?

1.4 Purpose of the Study

This study investigated the kinds of mathematics homework given to secondary school students, students and teachers' perception on its value and how certain variables associated with homework in secondary schools relate to achievement in mathematics

1.5 Objectives of the study

The objectives of the study were to:

1. Identify the nature and protocol of Mathematics homework given to secondary school students in Kenya.
2. Find out the opinions of secondary school students regarding homework

3. Investigate Teachers perceptions of secondary school mathematics teachers on the value of homework.
4. Examine the relationship between students' self-rating of ability in mathematics and perception of mathematics homework
5. Determine the relationship between homework and achievement in mathematics

1.6 Hypotheses of the study

To achieve the objectives of the study, the following null hypotheses were generated and tested:

HO1 There is no significant relationship between time spent on homework and achievement in mathematics.

H02 There is no significant difference between boys and girls on the amount of time they spend on mathematics homework

H03 There is no significant difference between boarders and day scholars in time spent on daily homework.

H04 There is no significant difference between Form 2 and Form 4 students in the time they spend on daily homework.

HO5 There is no significant difference between boys and girls in their perception of mathematics homework difficulty.

HO6 There is no significant difference between boarders and day scholars in their perception of difficulty of Mathematics homework.

HO7: There is no significant difference between Form 2 and Form 4 students in their perceptions of homework difficulty.

H08 There is no significant difference between Form 2 students and Form 4 students on attitude to Mathematics homework

HO9 There is no significant difference between boarders and day scholars in their attitude to homework

HO10 There is no significant correlation between students' self rating in mathematics and their attitudes to homework.

1.7 Significance of the Study

From a preliminary literature review, it was thought that this would be perhaps among the fewest studies in Kenya to address the issue of homework to some detail. It suggests ways of improving the management of homework for better student learning in mathematics. It is hoped that this study will provide reliable information on the extent of mathematics homework and its organisation in Kenyan Secondary Schools. It will also help parents, teachers and students, and school administrators to gain needed insights on how homework could be better organised to help improve performance in mathematics.

It could also, possibly, stimulate a need for more studies in the area as more questions are raised on mathematics homework. We need to study homework for us to be able to see why it works or why it does not.

1.8 Assumptions of the study

In this study it was assumed that:

1. Homework can contribute to student achievement and that it was given in all schools
2. Marks and grades obtained from schools and KNEC are reliable and valid measures of achievement.
3. School administrators, teachers, and students all share the same goal of attaining the learners' full potential performance in mathematics.
4. Views expressed towards mathematics homework are accurate and a good index for actual behaviour.

1.9 Limitations of the study.

This study concentrated on teachers and the students in their secondary schools even though it recognised that the home environment may also be important in promoting interest and persistence on homework tasks. The first IEA study of Mathematics Achievement reported that "pupils judgements of the importance of mathematics are associated with the extent to which their parents want them to do well, and to a lesser extent with their parents own attitudes towards mathematics", (Pidgeon, 1967:105). For purposes of economy, the parent and the social economic status of the students were deliberately left out of the research, despite them having an important role in shaping the aspirations of their children and motivating them towards schoolwork.

Secondly, there are many other environmental factors that would affect the mathematics mean grades at KCSE in schools, and student attitudes toward mathematics, which this study did not seek to control. For example, this study did not collect information on the actual ability of the students sampled, perhaps as measured by their last examination (KCPE), or how such scores could interact with their school to shape future aspirations and perceptions for particular respondents towards mathematics homework. It is hoped that, however, this study can serve as some beginning for further research in this area.

This study too took a lot of time to complete, having being done simultaneously with other regular teaching duties. For example, the pilot study was done in 1998 but the main study was done in 2000 due to logistical problems. Some aspects as is normal in a survey may have changed but the researcher is of the opinion that there are many other aspects of this study that remain valid for purposes of discussion on the situation in Mathematics homework.

1.10 Delimitation

This study was limited to secondary schools in Kenya. Specifically the samples were taken from Form 2 and 4 students and their teachers. Generalisations to other levels of education and to other classes in the secondary school must be applied cautiously.

1.11 Definition of significant terms

Head of Department (HOD): A teacher appointed to oversee and co-ordinate the academic activities of a department. Mathematics is a sub-department in the Science department, but in larger schools it operates as an independent department.

Homework focus: The extent to which homework is emphasised as shown by amount of homework, marking, and administrative involvement.

Kenya Certificate of Primary Education: (KCPE):The summative examination done at the completion of eight years of primary school.

Kenya Certificate of Secondary Education: (KCSE): The summative examination done at the end of four years of secondary school.

Kenya National Examination Council (KNEC): the National examining body which sets, administers, and processes the KCPE and KCSE.

Matatu: Public commuter vehicles

Out huts : A single or double room outside the main house, built for unmarried Male adolescents who feel uncomfortable sleeping in the main house, especially in the rural areas. Cooking is done from the main house.

Private Tuition/coaching: Practice of giving students extra teaching and preparation for examinations, usually for a fee, to raise their achievement in school and national examinations.

Protocol: Routines, practices that surround or are adopted in homework

SMASSE: Strengthening of Mathematics and Science in Secondary Education. A joint project of the Ministry of Education, Kenya and Japanese Government aimed at improving the teaching of Mathematics and Science in Kenya.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The review of literature focused on the pertinent areas of theory, practice, and research. It sought to help understand and form a basis for the present research on homework in secondary schools. In this chapter literature is reviewed in nine sections as follows:

(i) the theoretical framework for the study

(ii) sex differences and mathematics

(iii) attitudes and mathematics

(iv) students' self-rating and teacher expectations

(v) homework and achievement

(vi) homework and grading

(vii) practice, feedback and homework

(viii) mathematics and educational technology

(ix) conceptual framework

2.1 Theoretical framework

In this study, the behavioural approach to the understanding of learning was assumed. The behaviourist view is based on the definition of learning in terms of observable changes in behaviour. This theory is based on the stimulus - response -reinforcement model after Thorndike (1927) and Skinner (1961). According to Thorndike's law of effect learning involves forming bonds between situations (stimuli) and desired responses, asserting that the connection

between a situation and a response is strengthened when they are followed by a satisfying state of affairs (reinforcement). He further proposed a law of effect that the more a Stimulus – Response (S – R) bond is practised the stronger it becomes. Skinner emphasised the role of reinforcement in shaping behaviour, by reinforcing desired responses or their approximations. Operants (responses) which are reinforced get a higher probability of recurring. Behaviourists assume that learning is controlled by environmental variables. According to Joyce and Weil (1992: 292),

> People respond to variables in their environment. These external forces stimulate individuals to behave in certain ways: either to exhibit or avoid behaviours... From this stance the task of the psychologist is to discover what kinds of environmental variables affect behaviour in which ways. The educator ascertaining these relationships can apply the findings directly to his or her work – changing variables to change behaviour.

Desirable behaviour should be rewarded to increase its probability of being exhibited again. There are many environmental variables within the instructional process that can affect achievement in the secondary school (for example, Fraser et al., 1987:399), but this study will look at the context of homework in mathematics and how this relates to achievement in mathematics.

Bandura (1977) in his Social Learning Theory (now called social cognitive theory - cognitive because it explains about thought processes like cognitive theories) proposes an extension (revision) to the behaviourist position. Bandura

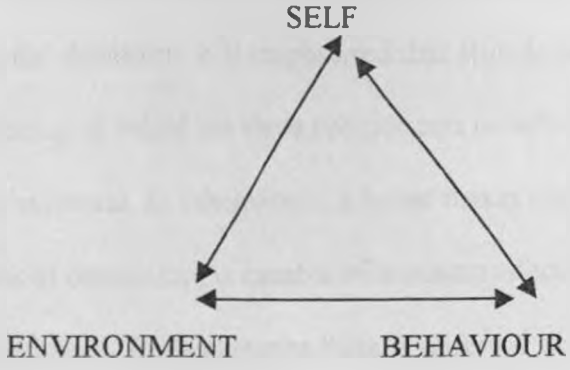
argues that for some social learning, reinforcement does not seem to play a critical role in influencing the individual's behaviour as advocated by firm behaviourists. Individuals model behaviour of others without prior practice and reinforcement. Reinforcement does not act directly but only causes individuals to expect certain consequences. Eggen and Kauchak (1997:215) summarise the teachers' role thus:

> Teachers should specify what behaviours will be reinforced so that students can adapt their behaviour accordingly, second, learners need feedback so that they know what behaviours have resulted in desired consequences.

To Bandura (1977:10) there is reciprocal determinism, in which personal factors, environmental factors and the behaviour all affect each other in an interlocking way. Bandura's three - point model shown in Figure 2.1 below is used to provide a general framework for the study.

Figure 2.1

The Reciprocal Relationships



For example, students may look at their environment, form an idea of what their efforts are likely to lead to and willingly decide to behave desirably. The eventual improved performance in mathematics is the behaviour which schools may wish to promote. This in turn may affect how students feel about themselves and mathematics, put the necessary effort in mathematics, pass in mathematics, be a model to a future class and so on.

The Social Cognitive Theory while admitting the importance of the environment emphasises that the latter interacts with two other components; the self and the behaviour itself. Viewed this way, it is important to consider how the individual's motivations and aspirations towards specific tasks interacts with the environment.

2.2 Attitudes and mathematics

There are many definitions of attitudes but according to Rokeach (1970:112) "an attitude is a relatively enduring organisation of beliefs around an object or situation predisposing one to respond in some preferential manner." By organisation is meant that an attitude is a cluster, grouping of two or more elements. From the definition, it is emphasised that attitudes are kind of permanent, enduring. A belief has three components namely: cognitive, affective and behavioural. In other words, a belief makes one say "I know" with different degrees of conviction, is capable of arousing affect and must lead to some action if activated. But sometimes there is observed discrepancy between behaviour and attitudes because he cautions that a person's social behaviour is

mediated by at least two types of attitudes –one activated by the object and the other activated by the situation.

Attitudes to mathematics or to homework would thus refer to the relatively enduring organisation of beliefs around Mathematics or homework that may lead to students acting in certain desirable ways towards Mathematics or homework. The student acquires and organises some beliefs, say, on whether Mathematics is enjoyable, hard, or useful as attitudes. Such attitudes are relatively enduring and may guide a students reactions to encounters with Mathematics /homework (Antonen, 1967). Part of the consequences of such endurance is the fact that deeply rooted attitudes are difficult to change, with bad consequences. Once attitudes have been formed, they can be very difficult to change.

> Positive attitudes assist the learning of mathematics; negative attitudes not only inhibit learning but ...very often persist into adult life and affect job choice. By the end of primary school years a child's attitude is often becoming fixed and will determine the way in which he will approach mathematics at the secondary stage." Cockcroft par.345.

Attitudes are very important in the learning and use of mathematics because they determine the students' willingness to study Mathematics. Callahan (1971). Bell, Costello & Kuchemann (1983). Teachers of Mathematics must concern themselves with the development of positive attitudes towards Mathematics, (Johnson, 1957). In fact, differences in ability to learn in upper primary schools

and junior secondary schools may be because of attitudes as Wall (1977:120) aptly states.

> Many of the differences have little to do with cognitive ability itself but in the differences of interests, attitudes, and motivations which have become established in primary schools and earlier, and which combine to make pupils unable or unwilling to profit from the kinds of education they are offered in the teens.

Negative attitudes to mathematics may be caused by difficult homework (Ashworth, 1981), and inappropriate or poorly thought out homework (busywork). Teachers must sincerely explain the value of homework given to the students and let their belief, attitude towards the importance of such work come through to students. This way students may not be hostile towards mathematics and may take the time needed to learn from homework, (Johnson & Rising, 1972:96).

In one nation-wide study on secondary school students' perception of Mathematics teachers and classes, Cooper & Petrosky (1976) asked high school students to write essays on their Mathematics classes. One finding of the study was that homework should be seen by students to be purposeful. Students complained that they were often not prepared for the homework they were asked to do and the homework was merely checked rather than used for instruction. Grambs and Carr (1979:319) similarly underlined the importance of perceived purpose in homework:

> If students see worth in an assignment, they will do it. It is that simple. Certainly most students will 'complete' assignments -whether mechanically, or by copying or by sharing in a division of labour with others – in order to stay within the bounds of safety. But the assignment in which students becomes involved is one for which they see a reason.

Difficult homework makes children experience repeated failure proving to them that they are no good, while poor homework makes the student doubt if homework has any value worth his time. (Ashworth, 1981), Arends (1995). Yet, Joyce and Weil (1992:312) noted that:

> It is clear both from research and from the author's own experience students are often asked to work from their texts or workbooks with almost no explanation and/or practice. Students need to have a high degree of success ...when they have received about 90 per cent accuracy on the structured practice examples.

Giving extra Mathematics work to students can also be discouraging and boring to good students, yet such exercises may not extend the students' knowledge. If the student is dissatisfied or discouraged by too much work, he may exhibit unfortunate behaviour or he may refuse to exert any reasonable effort to the task at hand.(Mutunga and Breakell,1987:221).

Callahan (1971) similarly states that pupils feelings are crucial for they have an effect upon the amount of work. and the effort put forward in learning mathematics. Unfortunately, in mathematics the student is reinforced positively

or negatively by every problem that they do, that they are good or weak at it. Bell, Costello and Kuchemann (1983:259) summarise the situation saying that:

> With Mathematics more than in any other subject the pupils work is likely to be judged in terms of simple 'right' and 'wrong' criteria. And that repeated failure must play a major role in determining motivation and attitudes to mathematics

Covington (1983) explained that since failure evokes feelings of unworthiness and self-rejection, individuals develop their own tactics of avoiding the implications of failure. High effort followed by failure arouses suspicions of incompetence while not trying minimises information about ones inability in the face of failure. Thus students tend to develop a:

> ...safe strategy for students when risking failure designed to minimise teacher punishment and reduce, at least temporarily, the shame and humiliation that accompanies failure: Try ,or at least appear to try, but not too energetically and with excuses always handy. p149

Similarly, the Cockcroft (1982:67-68) committee cautioned that:

> Mathematics is a difficult subject to teach and to learn [because its hierarchical] ... requires hard work and much practice, whatever ones attainment may be...whatever their level of attainment, pupils should not be allowed to experience repeated failure

Pupils should not be allowed to form negative attitudes since positive attitudes are necessary to the correct performance of Mathematics tasks. Yet, even negative attitudes can be changed by the patient teacher. Good and Brophy

(1991,318) say that the motivations of all students, even the most extreme case of failure syndrome or learned helplessness, can be carefully reshaped through socialisation designed to help them see that success can be achieved with reasonable effort.

Poor classroom teaching leaves students unclear of what was taught and exacerbates problems in doing homework given. The Cockcroft Committee (1982) on the teaching of Mathematics in Britain summarised reported adverse comments on poor teaching as follows:

> An alleged inability on the part of some teachers to explain clearly, on a tendency to ignore some of those in the class, on an unwillingness to answer questions and on moving through the course too quickly...and also of teachers who had not required their pupils to do sufficient work and of teachers who had been unable to state the purpose of the work which was being done- 'do it to pass your exams. Par.202

The socialisation of the student with respect to mathematics may also cause poor attitudes – how much emphasis do the parents and school community put on mathematics? Pidgeon (1967) contends that pupils' attitudes to mathematics are associated with the extent to which their parents want them to do well and to a lesser extent the parents' own attitude towards mathematics. In Kenya where a majority of students study in boarding schools for about 9 months in a year, the researcher would think that such a relationship might be ascribed more to the school than to the parents.

In a study of 259 Form 4 students in five schools, Rono (1991) found significant relationships between peer pressure to take certain subjects, pressure to do homework and achievement. Mathematics is commonly associated with failure and performing poorly in Mathematics may be quite acceptable in some groups but like Costello (1991:126) states, "the notion that successful people need not be embarrassed but can be rather proud of their inadequate mathematical ability is absurd and patently counterproductive"

The attitude to mathematics was found to be positively related to achievement in mathematics, (Aiken, 1970). Kibanza (1980) found that attitude to Mathematics scores correlated significantly with achievement scores of Form 2 students in Kenya. Fagerlind and Leal (1981) found the same to be true for upper primary school students in Portugal in a study on the effects of the school and the home on mathematics achievement. Fagerlind and Leal, however, found that teachers' experience and qualifications were not related to achievement in Mathematics. In the same study, it was reported that students of female teachers seemed to like Mathematics more than students of male teachers.

2.3 Sex differences and mathematics

Eshiwani (1974) in a study of 12 secondary schools in Kenya found slight differences in favour of boys in attitudes towards Mathematics. Pidgeon (1967) made a similar finding with girls enjoying Mathematics and being confident less than boys. Girls are more likely to perceive Mathematics as difficult as

compared to boys and "during the secondary [school] years, girls attitudes to maths deteriorate rather more than those of boys" Costello (1991:146)

Boys tend to outdo girls in problem solving while girls seem to outdo boys in computations. In prediction, a skill required in science and in Mathematics problem solving, Otieno-Alego (1989:182) found that "despite the fact that both sexes are poor at making predictions, the samples of boys had more competent achievers than girls". It is interesting that this was true regardless of class, with Form 2 boys doing better than Form 3 girls! This may be attributed to the fact that girls are raised in a more restrictive environment where conformity and dependence are emphasised (Graybill, 1975:341).

Girls are more reflective and careful while boys tend to be more impulsive and risk takers, guessing more, in an impulsive /reflective continuum. Boys also tend to persist at difficult tasks more than girls, (Scott-Hodgetts,1986). One would, thus expect girls to do classwork and homework much better than boys. In a study of 183 boys and 181 girls in grade 7 –12 (median ages 12 and 17 years). Emmerich (1978) found attitudes a function of age and sex with the older students being more self directed and confident. Sex differences in attitudes and achievement in mathematics have been associated with differential socialisation especially on what is masculine and feminine, Horner (1968). Girls are more likely to view mathematics as masculine, fear to succeed in such an area and thus tend to perform below their capacity because of the conflict involved in being successful, (Ernest, 1989). In fact girls are actually more

likely to be surprised by success because they more expect to fail, Costello(1991). Dweck and Bush (1976) found sex differences in learned helplessness with girls more prone to it. They defined learned helplessness as a belief that failure in a task is insurmountable and that further effort is futile. Girls are more likely to explain failure in terms of poor ability. Dweck et al (1978), Fennema (1981).

2.4 Student self rating and teacher expectations

Student attitudes are derived from their teachers' and to a lesser extent their parents ' attitudes, (Cockcroft, 1982). Mwangi (1982), however, found no significant relationship between a teacher's attitude to mathematics teaching and student achievement in mathematics. Costello (1991), reports that in good work, mathematics teachers are more likely to praise boys as talented (ability) in mathematics while girls are more likely to be praised for hard work, effort. In other words, boys' success is likely to be attributed to stable causes while girls' success is attributed to unstable causes. It would seem that teachers expected boys more than girls in mixed classes to succeed in mathematics. Leinhardt, Seewald and Engel (1979) found that in lower classes teachers made more academic contacts with boys in mathematics and more in reading to girls. (Badger,1981). Braun (1976) argued that teachers perceived girls' behaviour in the classroom as more compliant and consistent with academic norms.

Good & Brophy (1974) reported that low-expectation students do receive less praise and more criticism than high expectation students in evaluative feedback,

even through non-verbal class interaction. Such students are likely to be affected by the teacher criticism, perform even lower and in turn confirm the teacher's expectation. They reason that the students reaction to such expectations is dependent on the credibility of the teacher and the self image of the learner. Braun (1976:209) underlines the importance of the teachers expectation of students saying: " ...it is the 'teacher expectation of pupil' and the vicious cycle it triggers that will determine largely the child's self image, and ultimately academic success or failure." Wall (1977:138) summarises the situation, which appears even more applicable in mathematics homework, thus:

> His judgement of his own success or failure in a task is in part, a matter of whether he sees himself as able to perform satisfactorily; in part it stems from the judgement made about his performance by the teacher; and in part from comparisons he and others make between his performance and that of the best or worst in his group. ... to a very considerable extent controllable by the teacher ... and in how far tasks and criteria of successful performance are clearly defined and understood.

Covington (1983:147) makes a similar assertion saying that students' "failure evokes suspicions of inability...failure creates a feeling of unworthiness and self-rejection". The students feeling about him/her self is likely to depend on his perception of his/her performance relative to others in the class. This is likely to cause pupils to distort how they rate their ability. For example, students may view themselves poor so as not to be hurt by criticism arising from poor performance, (Bettleheim, 1961).

In a study, on the discrepancy between how teachers and students feel about a situation, it was reported that teachers perceptions of the school situation were substantially different from those of students. Teachers appeared largely unaware of the negative feelings of their students (Fleischman report, 1973), (Ishiyama & Chabassol, 1985).

2.5 Homework and Achievement

The study by Eshiwani, (1983) provided some useful insights on the factors that influenced achievement in schools of Western Kenya, among them homework. The study though, did not distinguish between prep and homework. Although the two aspects are related, this study distinguished between them and emphasised on homework because in it there is an implication for partnership between the teacher and the student. Kibanza (1980:124) in a study of 440 Form 2 pupils in Kirinyaga District, Kenya found among other things, that the "number of hours devoted to homework... to be poor predictors of achievement in mathematics". There was a correlation of 0.02 between homework hours and achievement on a test. He also found that pupil scores on attitude to mathematics were reasonably good predictors of achievement in mathematics. Di Napoli (1937) did an experimental study on mathematics homework involving 1200 children in 5th and 7th grades (the equivalent of upper primary school in Kenya). He assigned half of the students to half an hour of Mathematics homework which was included as part of the grade at the end of term, and an other half an hour of voluntary homework that was not graded. He

did not find conclusive evidence for homework, suggesting the contribution of other factors to pupils' school achievement.

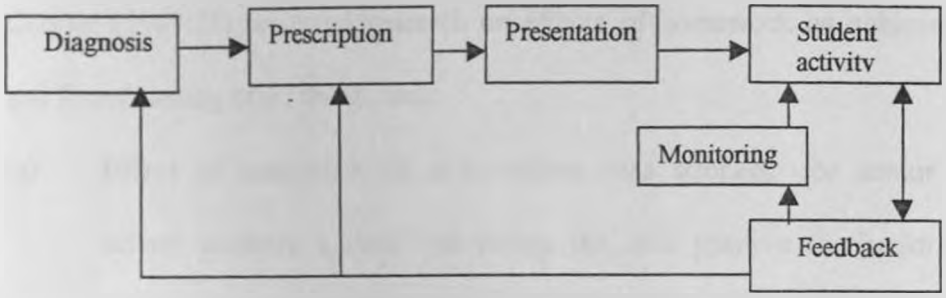
Rutter et al (1979:11) in a longitudinal study of 12 schools in London concluded that:

> Academically successful schools tended to have an emphasis on examinations and homework.... But it may well be that in addition to its practical value in providing opportunities for the consolidation of the learning of work introduced in school time, homework may also be of symbolic importance in emphasising the schools' concern for academic progress, and its expectation that pupils have the ability and self-discipline needed to work without direct supervision.

Fisher et al (1980) found that engagement rate (percentage of time students are actively engaged on a mathematics task) is related to students' learning and students who perform tasks at a high success rate learn more than those who perform at a low rate of success do. They also suggested a model with five teaching functions that are important in promoting higher academic achievement: Diagnosis, Prescription, Presentation, Student activity, Feedback and Monitoring. As noted earlier, for best results, the teacher must diagnose the learner's needs, prescribe a course of action, and get the student to do something. The instructor must keep on monitoring the process at each stage to take corrective action. Classwork and homework and the resulting monitoring and feedback are implied in the model.

Figure 2.2

Teaching functions that promote academic achievement



Source: Fisher et al (1980:10)

Similarly, Good and Brophy (1987:37) have observed the need for "carefully planning and co-ordination for increased instructional time to produce more learning, say, in mathematics ".

On the question of who benefits from homework, Ten Brinke (1967) reported a tendency for higher ability students to benefit more from homework. On the other hand, Marshall (1984) in two small group experiments involving elementary school children in grade 5 and 6 concluded that homework is beneficial for problem solving achievement but not for computational achievement. She also concluded that low ability mathematics students may benefit more from homework while higher ability students are likely to benefit more from classwork. Coulter (1981) reported that low achievers in secondary school were set little or no homework because teachers believed they did not posses skills or motivation to work independently and could cover their less demanding curriculum contrary to parent's belief that these low achievers

were the ones who needed it most. This only widened the gap between low and high achievers.

Cooper (1989:75) reviewed research on effects of homework on achievement and found among other things that:

(a) Effect of homework on achievement was strongest for senior high school students, a little less strong but still positive for junior high school students and absent for upper elementary students.

(b) Homework related to the learning of simple tasks is more effective than that related to complex tasks.

(c) Homework's effects on standardised tests, were similar to those on teacher made tests.

(d) Homework that focused on preparation for new content or practice of old content was more effective than homework related solely to content of present day's work.

Bond and Smith (1966) on homework in USA elementary schools found that homework involving independent research was given in only 15% of the districts, individual differences were ignored in assigning homework and only in one third of the districts was homework corrected, graded and returned. Lee and Pruitt (1979:31) present a typology of homework as follows: practice, preparation, extension, and creative. It was found interesting to be able to find out the kinds of homework given in Kenya and to what extent it agreed with sound learning principles.

Research on homework paints different pictures on the usefulness of homework. In a review of homework experiments in mathematics, Austin (1978) found sixteen favouring achievement, and thirteen showing no difference. That notwithstanding, Bruce (1986:44) in a study on raising school quality in developing countries suggests that " assignment of homework ... shows promise in raising student achievement." Similarly, the Cockcroft committee (1982:par248) implicitly accented to homework saying that:

> All pupils need opportunities to practice skills and routines which have been acquired recently, and to consolidate those which they already possess, so that these may be available for use in problem solving and investigational [sic] work ... practice of basic skills is not itself sufficient to develop the ability to solve problems or to investigate.

Although the results on the effect of homework may appear inconclusive, one would want to agree with Richards (1982) that:

> ...homework of the right kind under the right set of conditions positively influences academic achievement....However, uncovering all of the factors influencing homework and then unambiguously testing these factors in experimental settings will not be an easy task, for a wide variety of factors, some quite subtle, seen to effect the success or failure of homework.

On the other hand, Strang (1960:32), faced with such contradictory findings on homework research suggested that researchers unshackle themselves from the constraints and assumptions of rigid experimental designs and to first to

observe, identify and describe the teaching behaviours and teaching conditions related to homework. Those observations would provide clues that would be used to evaluate the success of homework against selected pupil characteristics. This study is a response to such call, for to know whether homework is useful or not in the Kenyan situation, one must study the homework in its Kenyan context.

2.6 Homework and Grading

Cullen et al (1975) experimentally manipulated negative and positive incentives in terms of grades to see what effect they would have on making students finish an easy assignment. It was found that students did more work if tied to a grade and negative incentives were more effective than positive ones. 58.3%, 35.9% and 86.4% of the students did not complete the assignment under positive, negative, and no incentives respectively. It is worth asking why some students (over one-third) did not complete the assignment whatever the type of incentive. This suggests that there are other factors, other than grades, that contribute to homework completion or non-completion.

Such factors may be, for example, students Locus of control, how the students view and value the grades; observation of student 'models' and academic focus of other close persons such as parents, teachers, and peers. Abidha, (1993), for example, found that students may prefer the strict, rigid authoritarian teacher and perhaps finish their work. Perhaps, this finding might apply in homework.

Moore (1984) in an investigation of the influence of locus of control and homework on achievement for high school students, found that the locus of control of a student had a positive effect on grades and test scores and that homework time influenced grades more than test scores. He also concluded that higher ability was associated with internal locus of control.

Teachers need to know why their pupils do not get problems right, not simply putting ticks and wrongs along attempted problems, Mutunga and Breakell (1987: 216). Cockroft (1982: par 415), in supporting the need for supportive marking observed that marking of written work is the form of assessment which is most apparent to a pupil and it should be both diagnostic and supportive. This way the teacher becomes aware of the kind of mistakes their students do and act accordingly.

Gray (1974:103) writing on assessment alerts the teacher to the possible negative effects of such marking of students work in that:

> pupils resist information about their performance if they feel it carries an unfavourable judgement of their personal competence. Whatever the intentions of the teacher may be, that's how marks and marking feels to many pupils, unless care is taken to anticipate and dispel the antagonism.

Weiner (1977), who observed that individuals avoid feedback and information as a protective coping strategy, has also echoed such concerns. The teacher will need to be aware of the needs of individual learners in assigning homework for

Moore (1984) in an investigation of the influence of locus of control and homework on achievement for high school students, found that the locus of control of a student had a positive effect on grades and test scores and that homework time influenced grades more than test scores. He also concluded that higher ability was associated with internal locus of control.

Teachers need to know why their pupils do not get problems right, not simply putting ticks and wrongs along attempted problems, Mutunga and Breakell (1987: 216). Cockroft (1982: par 415), in supporting the need for supportive marking observed that marking of written work is the form of assessment which is most apparent to a pupil and it should be both diagnostic and supportive. This way the teacher becomes aware of the kind of mistakes their students do and act accordingly.

Gray (1974:103) writing on assessment alerts the teacher to the possible negative effects of such marking of students work in that:

> pupils resist information about their performance if they feel it carries an unfavourable judgement of their personal competence. Whatever the intentions of the teacher may be, that's how marks and marking feels to many pupils, unless care is taken to anticipate and dispel the antagonism.

Weiner (1977), who observed that individuals avoid feedback and information as a protective coping strategy, has also echoed such concerns. The teacher will need to be aware of the needs of individual learners in assigning homework for

the feedback strategies to be meaningful. For example, Dacey (1976:2) cautions that reinforcement may not be effective for pupils who believe that they have no control over what happens to them ('external locus of control'),

In an experimental study, Christensen (1968) found that there was no significant difference in student achievement even when grading of students was suspended for one semester. Small, et al., (1967) found no significant differences in achievement between students whose mathematics homework was graded carefully each day and those whose work was occasionally checked by teacher. Similarly Austin (1976), in an experimental study of nine junior high school students found no difference in achievement between two groups whose homework was either corrected without comment or those whose homework was commented on after correction. Actually, only in two high schools did the second group outdo the first. These studies might suggest that either feedback is not important or that there are other factors that interact with homework to produce achievement.

Some secondary school teachers seem to recognise the importance of marking students work in raising student achievement. Mwaniki (1994:7), then a teacher of Mathematics in Strathmore School (a leading Kenyan secondary school), wrote the following on grading homework: " it is important for the learner to know why a full mark was not obtained for a particular question and what is needed of him or her to improve his or her future performance." He then proposes 66 correction symbols which he was using in giving feedback to

students after personally checking their work! At another level in the same school students are taught the virtue of hard work.

Griffins (1996:50), the Starehe school (a leading national school) director, emphasizes the importance of marking in the induction of new teachers which may well be applicable in any other school. " Starehe boys love two things: bread and marks...Thus it behoves teachers to mark with care and be able to justify their marking". He further narrates (p.16) an incidence where in studying students' end of term reports he noted that the performance of 24% in a major subject [read mathematics] was not up to par. On launching investigations he found out that:

> ...one teacher had not been marking his pupil assignments, thus leaving them without signposts; two teachers had rushed various topics despite pupils' protests that they had not properly understood

He then states that the problem was remedied, though it is difficult to tell if the students' improvement was due to grading of the assignments or due to the academic focus (concern). Okinda & Luciani (1994:20) another secondary teacher, in his guide on how to pass examinations testifies for the need to mark homework saying:

> "Assignment is the best way to do revision...the solution to finishing homework and still sparing some time to read is by learning to work faster...teachers should redouble their efforts in helping students succeed by marking late into the night. I did it and obtained results that were hard to believe."

In a paper on Teaching/Learning conditions in developing countries, Caillods and Postlethwaite (1989:182) also advocate for grading of homework to raise achievement that:

> teachers who spend time preparing lessons and marking homework and class work tend to achieve better results with their students than those who do not. If the homework is marked and gone through individually with each pupil, to help pupils to see their shortcomings and how to improve them, then the children learn much more.

From research, it appears grading homework may not be very useful in raising achievement whereas pedagogical evidence seems to suggest otherwise. One may think that either the research overlooked certain important contexts or the pedagogical evidence is exaggerated.

2.7 Practice, Homework and feedback

In this section some literature is outlined that helps put homework in the context of practice towards mastery. An old adage says, "practice makes perfect". Does practising skills always produce perfection. In what circumstances does practice lead to increased performance? Pearson and Tierney (1983), writing on reading practice research concluded that there is something missing in a 'practice only' approach to strategy learning. They proposed that future researchers must address the interrelated issues of the kind and context of practice, the explicitness of practice, and the ownership/autonomy afforded by the practice.

There's evidence to suggest that regular, "short, intense, highly motivated practice produce more learning than fewer longer practice sessions...all practice sessions should be monitored that boredom and apathy do not undercut their effectiveness." (Joyce and Weil, 1992:313).

Grambs & Carr (1979:319) also emphasize importance of homework that can be finished within reasonable time. The Jesuit Education Association Manual (1957) suggests that the total homework (for all the subjects) should not exceed 3 hours in a day for the average student. To arrive at the time students take for homework, the manual suggests that teachers do the assignment and allow students four times the time the teacher takes.

Students need to see why they should do homework before they can do it well. This is an area for motivation. In a discussion on motivation in work, Hackman and Oldham (1976) proposed a job characteristics model which relates feedback to motivation, especially internal motivation. They argue that skill variety, task identity, task significance, autonomy and feedback are five job characteristics which are necessary in a motivating job. For best performance the worker needs to experience three critical psychological states: meaningfulness (its important), responsibility (I am accountable, responsible for performance or non performance) and feedback (knowledge of how well I am performing).

They proposed that the motivation potential (MPS) of a job is related to the five job characteristics as MPS = [SV + TI +TS]/3 * autonomy * feedback. This means that the motivation potential is the average score for skill variety (SV),

task identity (TI) and task significance (TS) multiplied by autonomy and feedback. Since the average score is multiplied with autonomy and feedback this model implies that if either is missing (0) then the motivating potential for the job would also be zero! This underlines the importance of autonomy and feedback in performance.

Whereas this may be difficult to translate into practical calculations, the model would imply the fact that for students to perform well in Mathematics homework tasks (job), they need to know the importance of the homework, feel autonomous and be able to know how well they are doing. Marking of homework to give feedback, variety of the Mathematics homework given and teachers reactions to completion of homework are therefore some factors that are likely to influence students' motivation towards the mathematical 'jobs'.

Joyce & Weil (1992:313) outline a desirable approach to practice. It should start with structured practice in class as the teacher supervises, and "when the students are able to practise with accuracy, they are ready for independent practice under conditions when assistance is not available in the environment." Homework is an example of independent practice where students can practice doing mathematics on their own. To reap maximum benefits students should know what to do and how to do it.

Becker et al., (1975: 102) propose that as students master a skill, there should be a shift from massed practice to distributed practice, and from immediate

feedback to delayed feedback. In USA, Giannotes (1989) found that students in a cumulative practice group completed fewer assignments than the massed practice group. The cumulative practice group was less likely to believe that doing the homework given was useful in learning algebra.

Feedback should be provided regularly because 'Regular feedback is more desirable than sporadic feedback because it offers students more information and reduces the amount of time they practise making errors, if their work is incorrect'. Emmer et. al.(1984:45). On feedback, Arends (1985: 300) suggests that at the initial stages of practice students should get meaningful feedback and knowledge of results given in a positive manner. He further suggests that students should be taught how to judge their own performance (self-monitoring and goal setting) and not to be satisfied with extrinsic feedback from the teacher. Stiggins, (1994) similarly advocates that students be taught to evaluate their own work. Schunk (1994) observes that goals set by students are more effective than those imposed by a teacher. Bandura (1986), terms such a strategy as 'self regulation', a process where students influence their own academic goals.

Feedback provided should as far as possible refer to tasks and individual effort if it is not to be discouraging to the students. There is need to assess individual effort and achievement in providing feedback. Very often the teacher provides feedback on achievement without relating it to the effort individuals take to be able to show the student where improvements can be made or greater effort

required and in this way to transfer to the pupil himself the means of judgement of his performance. (Wall 1980:149)

The Jesuit High school administrators guide advocates strongly for homework as a practice phase in learning saying that "as long as Jesuit teaching methods are governed by Jesuit objectives, homework will always be an essential phase of the learning process" especially in mathematics and foreign languages. The manual however adds that students need feedback to persist in correct task habits saying:

> Homework is worse than useless if it is not regularly checked, corrected and returned. Students will not persevere in careful study when they know the teacher will not look at the results. They thus are practically encouraged to develop habits of thoughtless and slovenly performance. (p. 178)

2.8 Mathematics and Educational Technology

Galbraith (1967:12), a renowned economist defined technology as the systematic application of scientific or other knowledge to practical tasks. From this perspective, Educational Technology would therefore be the systematic application of scientific or other knowledge to the practical tasks of education. This conception of educational technology as a process is wider than the more common one which sees educational technology as a product (things of technology). For example, how can we raise the achievement of secondary

school students in mathematics given our facilities and curriculum? To this end, Rowntree (1982:1) states:

> Educational technology is as wide as education itself; it is concerned with the design and evaluation of curricula and learning experiences and with problems of implementing and renovating them. Essentially it is a rational problem solving approach to education, a way of thinking sceptically and systematically about learning and teaching.

Over the years, educationists have made several efforts to develop technologies of instruction to ensure a more effective instruction. Heinich et al (1985:306) defines a technology of instruction as: "a learning pattern designed to provide reliable, effective instruction to each learner through application of scientific principles of human learning". Examples are Programmed Instruction, Programmed Tutoring, Personalised System of Instruction (PSI), Audio-Tutorial Systems, Students Teams Achievement Divisions (STAD), Program for Learning in Accordance with Needs (PLAN), and Bloom's learning for mastery. The latter is a strategy for bringing all or almost all students to a specified level of mastery.

Block (1971:passim) has noted that mastery learning is especially useful in subjects that are highly structured, have a stable content and stress convergent thinking. (English and mathematics, for example, would be well suited to such techniques). It is based after Caroll's (1963) model of school learning and pupil aptitude that assumes that virtually all students can achieve mastery learning of a task if given enough time and good instruction. It has however, received its share of criticism especially that it slows down good students (Arlin, 1984) and

that it may lower the self concept of recycled students while inducing the better students to exert least effort to tasks.(Cox and Dunn ,1979).

In the Personalised System of Instruction (PSI) the students learn individually, on their own, and take tests to prove mastery when they feel ready. Proctors (student guides) usually provide them with tutorial support. The teacher acts mainly as a manager and planner of instruction. "The designers of PSI aimed to maximise rewards for conscientious study, minimise frustration, and eliminate fear connected with not knowing where one is going, how well one is doing and what surprise the instructor is going to pull on the final exam." (Heinich , Molenda and Russel , 1985:317). In Kenya's situation, the PSI and Bloom's Learning for Mastery systems, can be easily incorporated into conventional systems of learning to add effectiveness and efficiency. These principles can be adopted in homework to address individual students needs for mastery in mathematics.

Shiba (1986:306 - 330) has reported a successful private tuition programme in Japan called the Kumon Institute of Education. This technology of instruction has been used to improve the performance of students in structural subjects especially mathematics and English. It uses mastery learning techniques and students are then able to score high marks in school. It is reported that the method/system also helps students form the habit of consistent and independent study every day and learning to concentrate in school for future learning. After an initial placement test, students are given worksheets to work on from 10 - 25

minutes at home and 2 days in a week in a Kumon classroom. The students work on the worksheets every day, take worksheets for marking, and continue until a perfect score is obtained. Standard completion times of the worksheets are known, and student progress is measured against these standards, which also help to ascertain the student's 'just right' point (where worksheets are not too difficult or too easy). Students receive feedback often. Incidentally, the Kumon Education System is now in Kenya offering tuition to pupils in mathematics. The Kumon system reminds us of a well-organised homework scheme. It is possible to organise homework in ways that can ensure effective learning for individual learners.

If we accept that a goal of learning mathematics as a subject (including the KCSE) is skilled performance, then we need to find ways of applying the skill approach in teaching and learning of mathematics. Landa (1974) emphasises the need for teachers to analyse the skill to be learnt and design appropriate algorithmic instruction, knowing their learners. He warns against presumption that tasks are simple and obvious since the degree to which a task is performed automatically obscures the complexity of such tasks. Students need to be guided through such tasks, to practice the skills under supervision and independently.

Romiszowski (1981) suggests that in cases of poor performance, one looks at the performer and his environment. Did the problem learner ever perform well? Have they mastered the prerequisites, or is the task just boring? Questions such as these may guide us in looking for answers in the case of mathematics,

especially the contribution of homework. If homework is well planned, it can avail students with the opportunity in all the four stages in the skill cycle and to practise problem solving to skill level. Class time provides learners with the opportunity to acquire knowledge and to practise under supervision as he or she receives feedback.

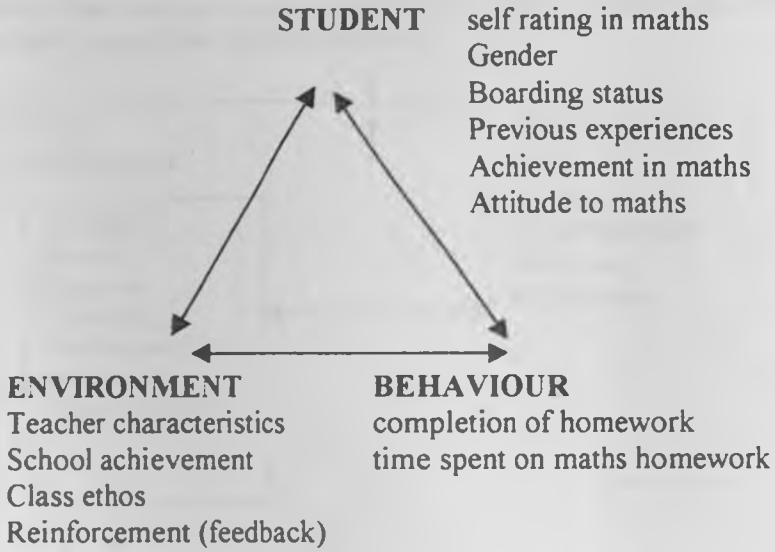
2.9 Conceptual framework

This study uses a behaviour-person-environment conceptual model using ideas from the Bandura (1977) model and Romiszoski (1981) skill learning cycle discussed earlier. The Bandura model ,shown in Ffigure 2.3 emphasises the reciprocal determinism between the personal, environmental and the behaviour factors in trying to understand how persons learn to behave in certain ways. Romiszoski (1981) also considers the environment important in analysing failure in performance. Rokeach (1970) similarly states that where there is discrepancy between behaviour and an attitude we must remember that an attitude is situational. For example a student may really hate mathematics but not be able to respond accordingly before their own teachers as this might be interpreted as rude. This way, we must understand a students' situation before we can make statements on why or how homework may be used to raise achievement.

On the student personal factors, we may include factors such as the learner's attitude, self-rating on how good (he) is in Mathematics and therefore how well he believes his actions can influence further good performance. On the environment, the researcher hoped to study the context, and nature of

homework given, how often it was checked, school performance (how well did previous students benefit from hard work?) in Mathematics.

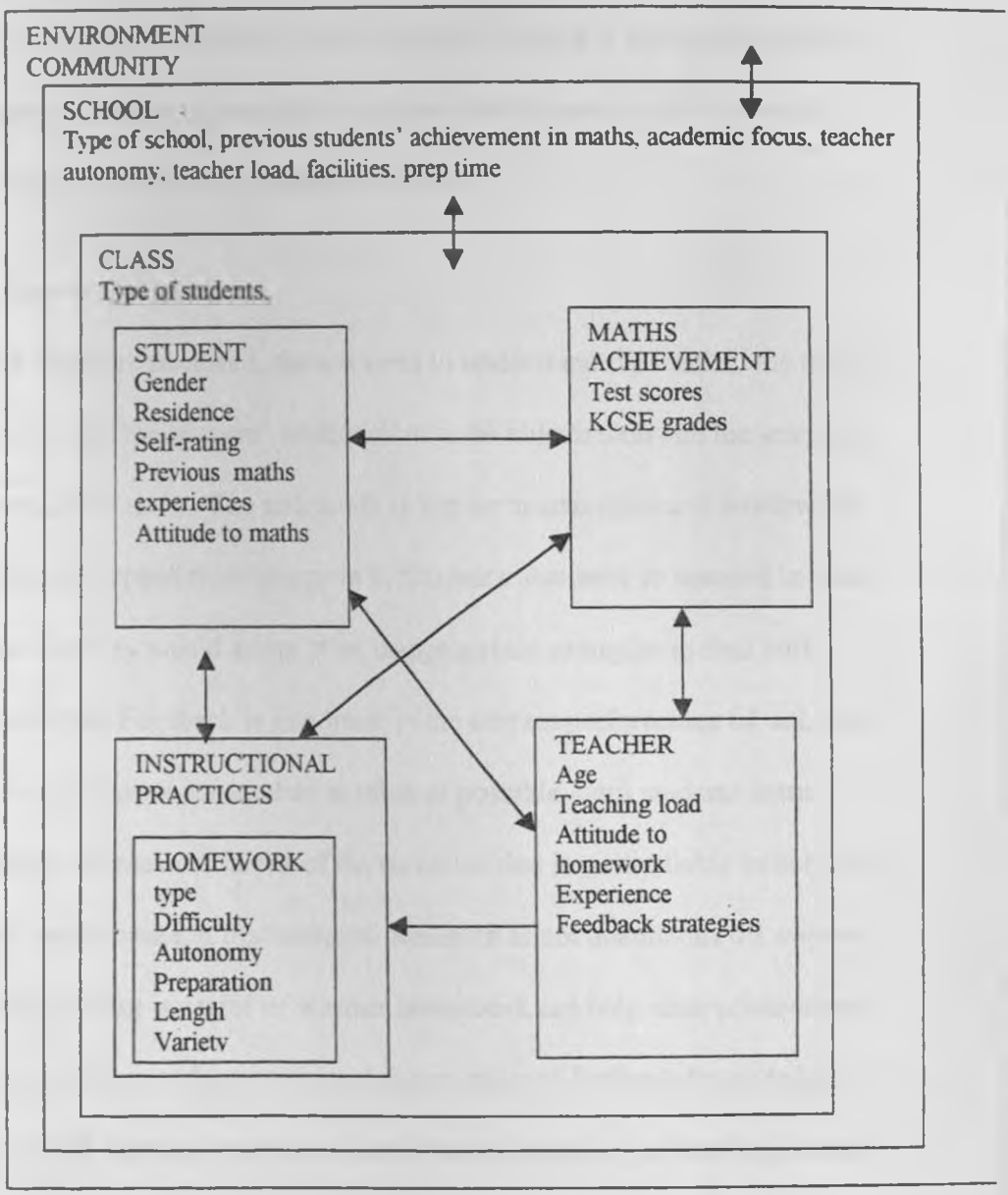
Figure 2.3
Reciprocal relationships in homework



Hackman and Oldham (1976) emphasise the importance of autonomy and feedback without which a task would not be motivating. They also emphasised the contribution of skill variety, and meaningfulness of a task as important in how motivating such tasks are. Romiszowski (1981) cautions that if learners under-perform yet there is enough practice, one should look at whether the task is intrinsically boring or if the learner is receiving adequate feedback. Pearson and Tierney (1983) similarly explained the importance of the kind and context of practice, the autonomy, and explicitness of the practice task in understanding such practice's contribution to perfection. From the foregoing discussion, Figure 2.4 below identifies some factors that are related to homework and achievement in mathematics.

Figure 2.4

Factors that may be related to homework



From the diagram, it is seen that a study on homework is likely to lead to an investigation of many other factors in the class and school. This study was mainly qualitative, dealing with a number of nominal and ordinal variables.

The following main variables were investigated: achievement as measured by class tests and KCSE (for the Form 4); attitudes to homework; Gender; homework time; Students residential status; teaching experience; Class; perceived homework difficulty, and students'self-rating in mathematics. This study has also attempted to qualitatively describe the nature and context of homework given in Kenyan secondary schools.

2.10 Chapter summary

From the literature reviewed, there is need to understand the learner, the task (homework) and the learners' environment to be able to motivate the learner in doing prescribed tasks. The task needs to appear manageable and worthwhile for students to expend their energy in it. Students also need to succeed in tasks set, otherwise they would adopt other inappropriate strategies to deal with resultant failure. Feedback is important in the correct performance of task and should be provided to the student as often as possible, until students learn to internalise it. Homework is one of the variables that is manipulable to help raise students' performance in mathematics. Research is not unanimous on whether homework grading is useful or whether homework can help raise achievement. However, intuitive evidence tells us that provision of feedback (knowledge of results) in skill learning is necessary and that one needs to put time in learning something to be successful. The researcher intended to study mathematics homework (what and how) in Kenya to throw some light on why homework in Mathematics may or may not be successful in raising Mathematics performance at the KCSE.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This study comprised a survey of mathematics homework practices at the secondary school level in Kenya. Homework as pointed out before is an aspect of mathematics teaching that is assumed to be present in varying degrees in all Kenya schools. The following sections describe how the samples were chosen and the procedures used to come up with the data in chapter 4.

3.1 Design of the study

The research design adopted is the cross sectional survey, which is appropriate in situations where the researcher does not have much control over the variables. Though the design has the weakness of lack of experimental control, and therefore it cannot raise definite answers, " it is likely that the primary value of the method is in raising specific questions about general problems that can then be explored more systematically using other methods " (Mason & Bramble 1997:45)

Descriptive research was chosen because of its appropriateness in collecting original data on this important topic and the possibility it offers in making descriptive assertions about a large population (Babbie, 1986: 228). Further, this is in line with Strang (1975:27) who suggested that on mathematics homework research:

> It may be more productive for researchers to unshackle themselves from the constraints and assumptions of rigid experimental designs and first

to observe, identify and describe teaching behaviours and teaching conditions related to homework , and then to proceed to evaluate them against a variety of relevant pupil growth measures.

Such information could help in understanding the current homework situation in mathematics learning and help provide another way of looking at the problem, in search of solutions. After the description of the status quo in homework, this study attempts to describe some relationships in the data as hypothesized earlier.

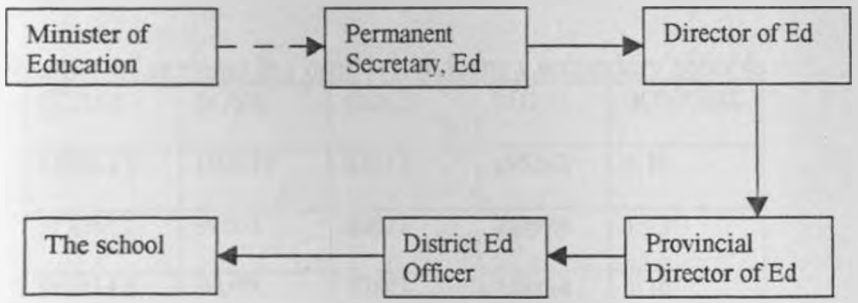
3.2 Population

The population under study consisted of secondary school students and mathematics teachers in Kenya. As pointed out earlier, mathematics is a compulsory subject for all primary and secondary school s in Kenya. This means that all the schools and students in Kenya form the population. The schools are located in different parts of Kenya.

Geographically, Kenya is divided into eight administrative provinces namely Eastern, Western, North Eastern, Central, Coast, Rift valley, Nairobi and Nyanza. A sketch showing the relative locations of each province is shown in the appendix. Each province is further subdivided into a number of districts, such that in Kenya they all total to about 65. (About 65 since they change from time to time). Each province is put under provincial administration appointed by the Central government, including a Provincial Director of Education (PDE). The PDE is responsible for the education standards in a province. Each district

is administered by a district team including a District Education Officer (DEO) headed by the District Commissioner. The District Education Officers are in charge of education in the district and are answerable to the PDE. This implies that each schools performance is under the guidance (line) of its principal (as heads of secondary schools are referred to), under a DEO, under a Director of Education.

Figure 3.1
Chain of Command in the Kenya education system



At each level of Director, Provincial and District education offices there is an Inspectorate section, which provides a staff (advisory) role in maintaining academic and other standards in the schools. Teachers, including the principals are hired and fired by an independent body, the Teachers Service Commission.

According to a schedule of secondary schools (schools, students and teachers) by Kenfric Industries (1991:91), Kenya then had a total of 2,654 secondary schools with 609,150 students and 28,056 teachers. The schedule showed that schools are not evenly distributed over the provinces. This is mainly due to social historical factors outside the scope of this study.

In 1998 and 1999, around the time the study was conceptualised, there were 3081 and 3234 schools with 700,538 and 661,824 students respectively (statistical abstracts 1998). The table 3 below shows the distribution of students by class as of 1998. The boy/to girl ratios worked in shows that the overall enrolment has increased steadily over the years with the boy/girl ratios decreasing over the years.

Table 3.1

Number of students In Form 1- 4 in Kenya secondary schools

CLASS	BOYS	GIRLS	TOTAL	BOY/GIRL
FORM 1	102449	92813	**195262**	1.10
FORM 2	98066	86922	**184988**	1.13
FORM 3	90293	77871	**168164**	1.16
FORM 4	82632	69492	**152124**	1.19
TOTAL	**373440**	**327098**	**700538**	1.14

Source: Central Bureau Statistics: statistical abstracts 1998

This means that a relatively higher number of girls was getting more access to secondary school education.

As already noted, Kenyan secondary pupils are admitted after eight years of primary school using the scores of the Kenya Certificate of Primary Education (KCPE). On average children start class 1 of the primary school at age six.

Thus, secondary school students will have an average age of fourteen and eighteen years for form one and four respectively. The KCPE examination was used and is used to select students for admission to Form 1. The best students go to national schools and the poorest to the local schools.

The schools in Kenya have a kind of traditional ranking as national, provincial, district, local, and private schools. Previously the government would give financial support to the schools in the order stated with the national schools getting the highest and the government-assisted schools getting the lowest. The categorisation then was government maintained school, government-assisted school, harambee (self-help) schools and private schools. The government schools were further categorised as national, provincial and district. National schools would thus have the best facilities while the government-assisted schools would have the worst. Nowadays all public schools (other than private schools) get financial support especially in the form of teachers' salaries from the government. The schools seem to generally maintain their earlier ranking outlooks though there are some notable exceptions.

The exceptions may be explained by the Form one students' admission system, and by the individual schools' peculiarities. To allow for an equitable distribution of the Form one places, a national school takes about five students from each district using the KCPE order of merit, subject to pupil choice. The provincial schools take the next best lot that was not selected by the national schools. A provincial school should take students from the administrative

boundaries of the province but again for reasons of equity the government has maintained that 85% of students must be selected from the district in which the school is located. This means that some provincial schools are essentially district schools but depending on the district of location they could have very good students of the quality in national schools. In fact some national schools have a class that selects students from within the province of location.

The district schools (these include community schools) select students last. Boarding schools are generally more popular than day schools with parents and thus district boarding schools are in high demand despite selecting students last. Due to the historical reason cited earlier, some district boarding schools have been able to build a tradition of excellence and therefore attract better students than provincial schools. Some 'district' schools are run more like commercial schools, their major aim to raise funds for the school and therefore would attract the poorest students that could not be admitted elsewhere. Admittedly some local day schools attract some very good students, initially selected to more prestigious boarding schools, but don't take up their place because of inability to pay high fees demanded by such boarding schools. This categorisation has was reasonably represented in the sample.

In describing the population, one should note that schools are also categorised by gender and by boarding status. Thus schools may be described as girls', boys' or mixed. They may also be described as day, boarding or mixed day and boarding. Using these two dimensions we can have girls' boarding, girls' day,

girls' day/boarding, boys' boarding, boys day, boys' day/ boarding, mixed day, mixed boarding, and mixed boarding/day schools. It may be noted that each province seemed to have its type of common types of schools. In the major towns there were more day schools than other schools while in the rural areas mixed day schools were the more common.

The number of teachers in the schools around the time of research are shown in the following table 3.2.

Table 3.2

Numbers and qualifications of secondary school teachers, 1999

TRAINED	MALE	FEMALE	TOTAL
Graduate	15271	9148	24419
Approved	3585	1637	5222
S1/diploma	5690	2977	8667
Technical	810	305	1115
Untrained			
Graduates	825	225	1050
Diploma/tech	1206	103	309
Total	26387	14395	40782

Source: CBS (Kenya): Statistical Abstracts 1998

Note: As shown above, 96.8 % of the teacher are trained. It is assumed for this particular study that mathematics teachers are equally well trained. In any case there are contradictory findings on the relationship between training and achievement. (Fagerlind & Leal, 1981), (Kirembu, 1991). Some research has shown that the qualifications of teachers are not critical to student achievement. One such study concluded that the educational and professional qualifications of teachers are not important at primary and lower secondary levels. (Simmons

and Alexander, 1980). The researcher did not go into the qualifications of teachers because it was thought that this could reduce teachers' willingness to respond. Mathematics is a relatively technical subject and it is more likely to attract qualified teachers to teach it.

3.3 Sampling

It was not practically possible to survey the whole population making it necessary to obtain a representative sample from which generalisations to the population could be made. The information in the previous section, with an update from the Ministry of Education documents at the provincial level, was used to obtain a representative multistage random sample.

For purposes of comparison and to allow the possibility of making broader statements about the population, it was decided to use half of the provinces for the research. A four-province sample was picked randomly from the eight provinces in the country. This was done by arranging the provinces alphabetically and numbering them from one to eight. The Province was chosen as a sampling unit because of its stability in representing the regions of Kenya. As noted earlier, the number of districts have recently changed from time to time. The provinces picked for the study were Central, Coast, Nairobi and western. In each province schools were selected to represent the types of schools using the gender/boarding criteria. The population that was used for sampling is shown in the Table 3.3.

Table 3.3
Number of Schools in Selected Provinces 1999

Province	Schools	sample no	%	weight
Central	570	18	3.16	1
Coast	160	11	6.87	2
Nairobi	105	10	9.52	3
Western	340	11	3.23	1

Source: survey at Provincial Education Offices

As explained before the different provinces had different preferred types of schools. However, all provinces had the first four basic types of schools, i.e. single sex schools and some other common type(s). For convenience purposes of this research sample, single sex day /boarding schools were treated like day schools. However, in such cases the individual student respondents were marked as day scholars or boarders so that this lumping together does not affect the analysis of the data. From the forgoing it was decided to use about ten schools from each province (two schools each from each of the five main categories, namely mixed day, boys' boarding, girls' boarding, girls' day, mixed boarding) but this was adjusted to reflect the realities on the ground.

Information on the number of schools was not readily available and the researcher had to go to the relevant provincial headquarters and conduct

searches for the information to help in constructing a sampling frame. Table 3.4 gives the number and types of schools that the researcher used in the provinces:

Table 3.4
Types of Schools Used in the Research in the Provinces

type	Central	Coast	Nairobi	Western	TOTAL
Boys Bdg	3	2	2	3	**10**
Boys Day	1	1	2	-	**4**
Girls Bdg	3	2	2	2	**9**
Girls Day	2	1	2	1	**6**
Mixed Bdg	3	-	-	1	**4**
Mixed Day	4	2	2	3	**11**
Mixed Day/Bdg	2	2	-	2	**6**
Total	**18**	**11**	**10**	**12**	**5**

Note: Bdg =boarding

In Kenya the summative national examination for the secondary school, KCSE, usually provides the mean scores for all the subjects each school presents candidates. The mean scores are based on the total number of points obtained by candidates in the subject divided by the number of candidates. $8 = \sum n_i p_i / \sum n$ where n_i is the number with grade i and p_i is the points for grade i . A = 12, A- = 11, B+ = 10,..., E= 1. Using these mean scores, obtained at the provincial education offices, the selection of schools for the research also considered the schools as higher, average or poor performing in mathematics.

Table 3.5

Number and Classification of Schools by Performance

CLASSIFICATION	PROVINCE			
	CENTRAL	COAST	NAIROBI	WESTERN
HIGH	4 (22%)	2(18.2)	2 (20%)	3(25%)
MEDIUM	5(27.8%)	3(27.3%)	3 (30%)	3(25%)
LOW	9 (50%)	6(54.5)	5(50%)	6(50%)

The higher performers were considered to be schools with an average mathematics mean score of (KCSE 1999 and 1998) between 5.5 and 12, average 2.5 up to 5.5 and poor to be below 2.5. This way some top performing and poor performing schools in mathematics are captured. This way in each province about 20% was in the first group, 40% in the middle, and 50 percent in the lower group. One must remember that mathematics is poorly performed with the national mean mark around 16%. The quotas above may thus be indicative of the real situation where the majority get low marks while a small group gets high marks. The information on schools that had been planned to be used is shown in table 3.5 above.

It was further decided to use Form 2 and Form 4 population for the purposes of drawing the sample. The Form 2 is the first class when the students are settled since the first year is spent settling to a new school and getting used to it. Form 2 students have also been described as restless and blamed for many secondary school strikes. It was considered an interesting group to study. The Form 4 class

was used because it is the last class in the secondary school system. Fourth formers do a terminal summative external examination (KCSE) which might affect their work patterns. The same KCSE scores were also to serve as a validation measure for the teacher made tests that were used in the study. Using the two classes was hoped to provide information on differences or similarities between students in them. For example, the two classes would help gauge if homework increased as students approach Form 4. In the year 2000 when the field study was conducted there were 86,318 boys and 80434 girls in Form 2 (totalling 166,752); and 83,032 boys and 72811 girls in Form 4 in Kenya secondary schools (totalling 155,843). (Republic of Kenya, 2001)

Initially it had been envisaged that ten students in Form Two and ten students in Form Four would be randomly selected to participate in the study, for purposes of economy. Assuming a class size of forty, this would have represented 25% of the sample. Two mathematics teachers in a school would be selected for the study. However, after the pilot study, it was found that some schools had many streams necessitating making a fresh decision on how to get a sample. Where there were more than two streams in a school, it was decided to use two streams selected randomly for selecting the student respondents. Consequently, it was decided to adjust the respondents in a class to between fifteen and twenty. It was found administratively easier to involve about half the class while the increased numbers would allow for statistical tests to be applied on class samples during analysis. The respondents in a class were selected systematically using the class list as a sampling frame. Teachers were asked to start from the

first student on their class list and pick every other student to respond to the questionnaire. It was found more practical to involve as many mathematics teachers in the schools as possible (after all they were below five in most schools), so long as they were teachers of a Form two or four class. Women mathematics teachers were especially encouraged to participate. It was assumed that teachers in a school would provide personal insights into the problem beyond their team /school perspective. The extra respondents would also help in taking care of attrition or non-response. Such a plan of action would have yielded the following numbers shown in Table 3.6 about here.

It was felt that the sample sizes above were adequate. There are no hard and fast rules to be followed in determining sample sizes (Johnson, 1977:142). There are formulae that can help in estimating sample sizes, for example, Ott (1988:13), but these require one to have prior knowledge of the population variance. One may need to go by the experience of other researchers to know the ranges of population variance in similar studies or estimate it after the pilot study.

Table 3.6
Expected Sample Sizes

Province	Schools	students	Teachers
Central	18	720	54
Coast	11	440	33
Nairobi	10	400	30
Western	12	480	36
Total	**51**	**2040**	**153**

Youngman (1979) and Balian (1981) think that a sample of 200 -300 is sufficient for a survey so long as sample sizes of 30 or more are maintained for statistical analysis purposes. Similar research in Kenya has used relatively large samples. Okumbe (1992) in a study of job satisfaction of graduate teachers in Kenya used 30 schools in two districts and in so doing sampled 243 graduate teachers. Kimani (1991) used 705 in-service teachers, Somerset (1969) 1543 form 4 students in 24 secondary schools in Kenya, while Nyaga (1997) used 408 students and 62 teachers from one (Embu) district.

Due to the administrative and stratification purposes (analysing the data in small groups) it was felt necessary to have a relatively big sample. It will also be remembered that a sample is picked for the purpose of estimating the population parameters. "No matter what the shape of the underlying distribution of the scores, the sampling distribution of the mean will tend to be a normal distribution with a mean μ." (Mason and Brabble :195). The sampling distribution of the mean is the distribution of the mean of specific samples drawn from the population. The standard error of the mean (the standard deviation of the sampling distribution of means) is estimated from the standard deviation and population size as $\sigma_{\bar{x}} = \sigma_x/\sqrt{n}$. $\sigma_{\bar{x}}$ is inversely proportional to $\sqrt{n}$ and thus as the sample size n increases, $\sigma_{\bar{x}}$ decreases. As n approaches the population size, $\sigma_{\bar{x}}$ approaches zero. Within practical limits then, the larger the sample, the smaller the standard error of the mean, and the better. The larger the sample size the closer to the population values, a quality called precision.

3.4 Instrument Development

This study used questionnaires, an interview schedule and an observation schedule. No suitable published instruments were available to investigate this topic. The researcher developed own instruments to collect required data based on the objectives of the study. Two self administered questionnaires, one for teachers and one for students, consisting mainly of closed questions; an observation and interview schedules were used. The instruments were pre-tested and improved on later during the pilot study.

3.4.1 Students questionnaire

The students' questionnaire was designed to collect information on homework from the students' point of view. It was designed to contain more items than teachers' questionnaire for it was expected that students would be more willing to respond and are more reliable in their responses, Aubrecht (1986); Mosley and Smith (1982). Redundancy was built into the questionnaires to help check on the consistency of responses between items and between respondents. For example both teachers and students were asked how often homework was given and marked.

The students' questionnaire had an introductory section with a request to respond sincerely, it not being a test, and with a pledge of confidentiality. A second section elicited the respondents' biographic data that would help in the analysis and interpretation of the responses. The fourth section solicited the

respondents' attitudes and opinions relating to homework administration in secondary schools.

In the third section students were required to choose one or more answer that best described their views, but to add other answers where they felt necessary. Some questions were left deliberately open ended for students to describe their positions. The instrument in full can be found in the appendix D.

The last section in the students' questionnaire required the respondents to react to statements on a Likert-type scale with five choices. The students' questionnaire had thirty (30) items. For example, students were asked to Strongly Agree (SA), Agree (A), be Undecided (U), Disagree (D) or to Strongly Disagree (SD) with the following statements.

1. Homework is a waste of students' time

   SA ..... A..... U..... D..... SD.....

2. I enjoy doing mathematics homework

   SA..... A..... U.... D..... SD.....

The responses were put below each of the statements in a bid to reduce response set where students tick one category even without reading the statements. The scoring for six items were reversed while the " SA: A: U : D: SD:" response order was retained, to further safeguard against response set. This, together with the instructions at the beginning of the questionnaire

(encouragement to respond sincerely and the promise of confidentiality) was expected to contribute to the reliability of the instrument. It will also be noted that some questions were asked indirectly, assuming that people will be cautious in making statements that are likely to get them to be seen in negative light. For example, students were asked 'why do some students not complete homework' rather than 'why don't you complete homework' or 'Students need to be supervised when doing homework' rather than 'I need supervision during homework'. The questionnaire was printed on pink colour to attract pupils' attention.

3.4.2 Teachers' questionnaire

The teachers' questionnaire was printed on green paper for easy distinction from the pupils' questionnaire. It was structured after the students' questionnaire; to supplement the latter, but also to provide information on teachers' perception on homework. Teachers were requested to provide information on the frequency of assigning and marking homework, sources of homework and on their views on the importance of homework.

The questionnaire had an introduction, biographic data section, questions section and an attitude/opinion section with twenty items. Some questions in the attitude section were actually perception questions, but it was found necessary to measure some of those opinions on an ordinal scale.

3.4.3 Interview schedule

An unstructured interview schedule was developed to investigate the positions of different schools on homework, and to find out if any procedures were

adopted to ensure that teachers and students followed the school policy. The interview schedule was used to guide a discussion with the school principal/deputy principal.

3.4.4 Observation schedule

An observation schedule was used to observe the class environment in which homework is assigned. The researcher observed the kinds of homework given, and any structuring activities such as explanations on homework in ten randomly selected schools. Four, three, two and one schools were selected from Central , Western, Coast and Nairobi provinces respectively depending on the relative number of schools. A Form 2 and a Form 4 class in a selected school were observed All in all, seventeen classes were visited. The researcher personally attended and observed mathematics classes in eleven classes. It must be noted that the classes were visited with the teachers' consent and this may have interfered with the observation.

3.4.5 Mathematics tests

Two mathematics papers set and scored by the Kenya National Examination were done by all Form four students in the sample. The marks the students got in the two papers have been averaged out of 200 and converted to a grade on a scale of 1 to 12. It was assumed that the KCSE mathematics papers were reliable and valid having been set by the national examining body, the Kenya National Examinations Council.

Copies of the instruments are appended at the end of the research report.

3.4.6 Validity

Much care was taken to ensure the validity of the instruments through three ways. First, the items for the instruments were developed around the objectives of the study. Major concepts and routines in homework were listed, a number of items drafted, studied and revised as necessary while following guidelines suggested in literature, for example, Balian (1981: 76 - 78, 84) and Prewitt (1975: 70 - 90). Items used were those judged useful to answer the research questions.

Secondly, three experts from this field scrutinised the instruments for logical (content) validity and to help improve on clarity. Finally, the pilot study was used to observe the construct validity of the instruments especially through item analysis. Items were added, modified for clarity or dropped as necessary to improve on the validity of the instruments at every stage.

3.4.7 Reliability

The reliability of a measuring instrument is an indication of its repeatability. Reliability analysis using the split – half method was attempted to establish the reliability of the attitudinal part of the students questionnaire. The reliability score for two schools was found to have a split half correlation coefficient of 0.803. This was adjusted using the Spear-Brown Prophesy Formula to compensate for the reduction of the test by half (in the split half method). The Spear-Brown prophesy formula is given by $2r/1+r$ where r is the Pearson correlation between the two halves. The correlation was thus adjusted to 0.891.

About half the items had an inter-item correlation of over 0.500. It was however, noted that the reliability coefficients varied with the number of items and respondents used. Where some respondents left out some items this seemed to affect the scores.

The two mathematics papers for the Form 4 were assumed to be valid and reliable in line with the KNEC's mandate. In their year 2000 KCSE report (KNEC 2001:v), the KNEC explained its mandate as:

> To develop and administer examinations annually for (KCPE), ...(KCSE) and Post-schools candidates and to ensure that these examinations are free from **bias** and are **valid, reliable**, **relevant**, **efficient** and of globally **accepted standards**...To achieve its mandate... the council **develops**, **moderates, prints, distributes, administers, marks, processes examinations** and awards certificates...

3.5 Training of research assistants

This study made use of two research assistants to help in data collection. The researcher explained the research design to them, and trained them on procedures to be followed for data validity and reliability. The research assistants were used to help administer instruments, collect needed data in the schools and to follow up as necessary. The pilot study was particularly useful in the training, since they accompanied the researcher in the visits to schools.

3.6 Pilot study

The pilot study conducted in the second school term 1998 was an important stage of this study. It was expected that this would help to review the instruments, the subjects, the environment, and the process and loopholes in instrument administration as Balian (1981:90) cautions:

> The vast majority of doctoral and professional researchers would have been better of in taking less time to actually collect data and more time pilot testing ....the pilot test allows the researcher to review instruments, subjects, the four special hazards, and actual test administration, all in one operation and simultaneously.

In view of the importance of pilot testing, a pilot study was conducted to help improve the research instruments and data collection procedures. The researcher and the research assistants worked together in the pilot study to acquire the necessary experience and to enhance reliability in collection of data in the main study.

A sample of two schools in two provinces was used for the study. Up to fifteen students in a class and two teachers were selected from each school. One school was a girls' school while the other was a boys' school. This made a total of 55 students and eight teachers.

The researcher learnt a lot during this pilot study stage. First, he was brought into contact with real respondents and real mathematics teaching situations.

This forced the researcher to modify some strategies that had been suggested earlier. It was mentioned how the numbers of respondents had to be revised for easier administration of the questionnaires. Again, it was obvious that despite the assurances of confidentiality some schools and teachers were suspicious and would not give the study their full co-operation. Most teachers though were enthusiastic about participating in the study.

For example, it had been envisaged that teachers would give their identities in the questionnaires for follow-up in the study (for example to find out how their perceptions of homework affect their students') but the general reaction was to omit names. The researcher had to go through the school principal who would instruct/request the Head of Mathematics/Science Department to get the participants. The Head of Department would in turn ask mathematics teachers to fill the questionnaires or refer the researcher to the teachers. The definite control of responses that the researcher planned for was not obvious. The researcher could not move at his pace but would have to negotiate with others. The questionnaires had to be reworded to get more information and to check for contradicting information.

Some heads also expressed their concern that the study would take a lot of their pupils' time. The students' questionnaire took about twenty - six minutes to fill and the mathematics test about an hour for the slower students. There was concern expressed by the teachers that either their students had not covered the material tested or that they would not administer it to their students for it did not

meet their standards. The questionnaire had to be edited to take about eighteen to twenty minutes and the mathematics test dropped and replaced with teacher marks in two consecutive terms around the time of the study.

All this meant that the research would move at a slower pace than envisaged. In the actual study the researcher decided to get information piecemeal to tap the teachers co-operation better. For example the observation, interviews, students' questionnaire, teachers' questionnaires, and requests for marks were done at different occasions (however, the overall picture of the request was mentioned to the school Principal in an introductory letter seeking permission to do the research). It was also found necessary to write a 'Questionnaire administration instructions sheet' guiding the teacher on how to administer the questionnaire in cases where the researcher/research assistant would not be allowed into the classroom.

Some responses that were previously not included in the questionnaires were added in depending on their popularity with the respondents. Some items were added or dropped from the questionnaires or their wording was improved on.

3.7 Students' mathematics achievement data

As mentioned earlier it was realised that administering the achievement test set in all the schools was administratively harder than envisaged. In most cases, the school authority did not mind the test but the researcher would have to schedule the test with a mathematics teacher, and this depended on the co-operation of

the teacher. Further, it was found difficult to schedule a test that would occupy a fraction of the class, even after class time. On the other hand some pupils did not write their names on the questionnaires and the test answer sheets implying a need for non identification, or simply wrote their names and left the instruments unfilled. .

In this case, it was decided to use the average mark awarded by the class mathematics teacher in end of term examinations. The end of first term and second term 2000 (when the study was done) marks in mathematics were used since these marks defined the student at the time of the study. These marks were used to provide a measure of achievement in mathematics in the study.

These, too, were the marks that the students saw and perhaps reacted to (in terms of reinforcement or forming expectations on better future performance). While the marks for the previous term were available, the researcher had to wait for the marks of the end of term during which the research was conducted.

Despite the disadvantages of lack of control over the validity /reliability of these marks, the researcher sees them as a rough (raw) indicator of the pupils achievement in Mathematics. This system was found to have three advantages:

(i) the marks for each student was/ would be available without the student being aware of the fact

(ii) no further time would be required to schedule tests in schools

(iii) there was/would be an indirect validation by the teacher on whether names given by students were real or fictitious.

The marks were judged to be good enough because:

(i) In the bigger schools, examinations, including mathematics and science are set by a panel using set guidelines.

(ii) Where the SMASSE (Strengthening of Mathematics and Science in Secondary School Education) project is on, Form 2 and Form 4 students do common examinations at the district level.

(iii) Mathematics is a structured subject with a tendency towards convergent answers. In such circumstances it may be assumed that the deviation of teacher awarded marks is less compared to subjects like, say, history.

(iv) Many mathematics teachers are involved in marking the KCSE and are thus familiar with standards of marking and setting examinations. Most of the schools also did a common district mock examination in the second term. Such examinations have a common marking scheme.

The disadvantage is that the marks are obtained from different tests, different conditions, and different teachers. The average of two scores obtained by the student at two different examinations is expected to be a better indicator of how good an achiever the student is in mathematics. The correlation between the two terms' marks in all classes is high in the order of more than 0.8. For the Form 4 class the validity of the teachers' marks is supported by medium to high correlation between their scores and those of the KCSE. This agrees with Cooper (1989) who observed that the effect of homework on teacher made tests

was similar to those on standardised tests. As a further validation, students were asked to rate themselves on how good they were in mathematics.

3.8 Data collection

3.8.1 Procedure

A letter seeking to be allowed by the school principal to do research in the school was sent in advance. Thereafter the researcher went on a convenient date, reported to the school head. Where the principal was not found, the researcher or research assistant reported to the deputy principal. In most cases the researcher was sent to the Deputy Principal for assistance or to the head of science/mathematics department to assist with the practicalities of questionnaire administration. The head of department would handle the test administration or would delegate the questionnaire administration to some other willing teacher. The teacher delegated to would in turn administer the questionnaire or allow the researcher/research assistant into the class to do the same. In most cases the researcher would insist on waiting for the student questionnaires or would be given a date when to collect the completed questionnaires. Most teachers assisting were co-operative but there were some in isolated cases where the students would be rushed through even without fully completing the questionnaires.

3.8.2 Observation

The researcher made seventeen visits to mathematics classrooms. This helped to validate the questionnaire responses and indicate how homework is actually

handled in class. The researcher observed homework structuring activities and time taken for such activities, and obtained samples of pupils' mathematics exercise books. The researcher made an effort to establish good rapport with the teacher to minimise the halo and the Hawthorne effects.

3.8.3 Administration of questionnaires

Student questionnaires were administered in class at a convenient time, as advised by the school administration, to selected students. The administration of the questionnaire was done by a school teacher, researcher/ research assistant or both. Teachers were given the questionnaires and encouraged to respond without much delay. The researcher or a research assistant made a deliberate effort to get the co-operation of mathematics teachers to get the questionnaires filled in the same day or at most within the week. Some teachers, however, delayed with the questionnaire beyond a week. Where the questionnaires were misplaced or lost the individual teachers were requested to fill another one.

3.8.4 Administration of interviews

School heads or deputy heads were interviewed by the researcher or research assistant using an unstructured interview schedule. The interviewer had a micro-cassette recorder to help record responses accurately and unobtrusively. This way it is believed the responses were more spontaneous and sincere. The responses were transcribed and coded later after the interview.

3.9 Units of analysis

This study analysed responses given mainly at the individual respondents' and school level, but also at the provincial level to a limited extent. The schools and individuals seemed to interact with each other, and provinces seemed to have their peculiarities too. The school was used as the sampling unit.

3.10 Variables in the study

This study used the following nine main variables:

1. Mathematics achievement as measured by class tests and KCSE (for the Form 4); 2. attitudes to homework; 3. Gender; 4. homework time; 5. residential status; 6. teaching experience; 7. Class; 8. perceived homework difficulty, and 9. students'self-rating in mathematics.

3.10 Data coding and Analysis

When questionnaires were returned to the researcher or /research assistant, they were checked for completeness and any necessary step taken. It was noted that in some cases the students did not complete filling in the questionnaire, a page may have fallen off, or they had not given their names, even after encouragement to do so, for possible follow-up or would leave some questions blank. Some did not even return their questionnaires. For purposes of comparison the fact whether a student gave his/her identity was coded as a dichotomous variable. Gaps in the questionnaire were left as gaps in the relevant school code sheets.

The questionnaires were labelled by the school they came from, and numbered to facilitate easy identification during the coding process. The questionnaire was labelled with a number that identified the school and the respondent to prevent mix up or for future cross-checking of responses. For purposes of confidentiality and anonymity, all respondents (teachers, students, and schools) are referred to by code numbers. The identification numbers for the students and teachers are related to that of the school for easy reference. The number identifies the school- class/province - respondent. For example the number 25:4-13 identifies respondent 13 in Form 4 of school code S25, while the number 10:1-13 for a teacher identifies a teacher no. 13 from school code 10 in province 1.

The questionnaires were summarised into code sheets for each school and class by either the research assistants or the researcher. Two code books were prepared incorporating the variables investigated in the students' and teachers' questionnaires. The returned questionnaires were processed against these code books.

The researcher and the research assistants did the coding. The work was quite tedious and took a lot of time. The coding involved converting the pupil responses to numeric values that could be used by the computer for the data analysis. The code sheets could not cater for all the possible responses of students /teachers but they did cover the more frequent ones. New alternative coding was added when it became clear that a particular response was actually

different than those provided for. Pupils in different schools came up with new categories that could not fit into previous ones.

It was necessary to continually revise the list of responses to a particular item or the list needed to be revisited to accommodate a new choice. But an effort was made to make the categories as independent as possible. Where the possible categories of responses were modified, a note was made against the necessary item on the code book. Most of the questions were straightforward and there were no differences between the coders. Some students though would add other responses than given in the options. Differences would usually occur where the respondent had modified their answer from that given, or had given a qualifying statement that would probably change their answer from one code to another. In such a case, the coders would differ on the coding. Those other responses were added as options where it was felt they introduced a different idea from any in the options. The researcher went through all the code sheets and rectified any errors in coding that may have been there. The researcher has checked and rechecked the individual group code sheets against the original pupil responses for consistency of coding, so it is as if all the coding was done by one person.

The data collected was entered into the computer, checked and cleaned for obvious errors, for example where a value was typed that did not correspond with the values allowed for the variable. The error would be corrected, and perhaps the source of the error noted. The important variables were checked for the characteristics of the distributions using P-P or Q-Q plots.

The data was analysed using the Statistical Package for the Social Sciences (SPSS). Because of the computer facility, it was possible to analyse the data in different ways to follow up the hypotheses and objectives of the study. Descriptive statistics, such as measures of central tendency (mean, percentages etc.) and inferential statistics (such as contingency tables, χ^2, t /F tests, ANOVA, correlation, Mann-whitney U and Kruskal-Wallis H tests) with respect to the hypotheses and objectives of the study were used and reported accordingly.

The interviews and observations made during the study helped in the analysis and interpretation of the data obtained from the questionnaires.

CHAPTER 4:

DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter presents the analysis of the data collected and a discussion of the same. The study was aimed at achieving the following objectives:

i) Identify the nature of mathematics homework given to secondary school students

ii) Find out the opinions of secondary school students regarding homework

iii) Investigate secondary school teachers perceptions on homework

iv) Examine the relationship between students self rating on ability in mathematics and their perceptions of mathematics homework

v) Determine the relationship between homework-related variables and achievement in mathematics.

The last two objectives were translated into several hypotheses, which this study tested and reports. The data collected in the study, findings and the attendant discussion are presented in this chapter.

4.1 Questionnaire Returns

All in all 1783 students responded to the questionnaire making 87.4% of the expected return. The students were from rural (43%) –away from town, semi-urban [small towns or suburb of a city] (34%) and urban schools - in a city - (23%). Most day students in city schools take a 'matatu' to school while only some in a semi-urban school use such means to get to school. Almost all day scholars in rural areas walk to school. This return rate is considered acceptable.

Some of the questionnaires may not have been given to students for some teachers seemed to have kept at least two copies of the 40 questionnaires given. In some two schools the number of questionnaires were less because some were erroneously given to Form 3. All in all, 147 out of the expected 153 secondary school mathematics teachers responded to questionnaires making 96.8%. Table 4.1 is the breakdown (by specified strata) of the numbers of student respondents from the provinces sampled.

Table 4.1
Student respondents by province, Form, gender, and residential status

province	Form	no.	%	gender	no.	%	boards	no.	%
1	2	185	52.1	male	147	41.4	day	248	69.9
	4	170	47.9	female	208	58.6	board	107	30.1
	Total	355	100.0	Total	355	100	Total	355	100.0
2	2	321	50.3	male	296	46.4	day	264	41.6
	4	317	49.7	female	342	53.6	boarder	370	58.4
	Total	638	100.0	Total	638	100.0	Total	634	100.0
3	2	201	50	male	211	52.5	day	129	32.8
	4	201	50	female	191	47.5	boarder	264	67.2
	Total	402	100.0	Total	402	100	Total	393	100.0
4	2	191	49.2	male	224	61.0	day	189	48.7
	4	197	50.8	female	164	39.0	boarder	199	51.3
	Total	388	100.0	Total	388	100.0	Total	388	100.0

Nb: Each column data refers only to the relevant province.

4.2 Demographic data

The student mean ages were 16.15 years and 18.02 years for Form 2 and Form 4 students respectively. At the 0.05 (and 0.01) levels the boys were significantly older than girls with means M_1 = 17.27 (1.46) and M_2=16.88 (1.27) respectively and boarders seemed to be younger than day scholars. This seems consistent with the observation that the better students, with minimum repetition in classes are more likely to go to boarding (read relatively better) schools while the weaker go to day schools. The age groups are summarised here below in years:

Table 4.2
Mean ages of students by gender and class.

Class	gender	No.	M(yr.)	SD (yrs)
Form 2	boys	442	16.32	1.07
	Girls	452	15.98	0.90
Form 4	boys	428	18.26	1.12
	Girls	448	17.79	0.90

The achievement of boys and girls in mathematics differed with means M1 = 31.51 (21.02) and M2 = 27.94 (20.11) respectively. These means were statistically different at the 0.01 (and also the 0.05 levels).

Students had been asked to identify themselves for the sake of any other follow-up. The following are the percentages of students who did not identify themselves by giving their names: Form 2: boys (n=442) 9.3%, girls (n=453) 4%: Form 4: boys (n=434) 2.8%, girls (n=450) 7.1%. One sees that the Form 2

boys and Form 4 girls had relatively higher numbers of students who did not give their names on the questionnaire. Perhaps this may indicate that in the lower form mathematics teachers are more demanding (perhaps intimidating) with boys than girls but become more demanding (or at least are perceived so) with girls in Form 4.

4.3 Responses from the students questionnaires

The researcher wanted to find out how often homework is assigned. It had been thought that homework frequency was different in different schools with perhaps the better schools getting homework more frequently. The researcher was surprised to find that in almost all schools visited, 95% of students (1779) got homework at each mathematics lesson. Only in a very few (five classes out of about the 200 classes in the study) cases was weekly homework (not after every lesson) assigned. The classes where students were assigned homework weekly appear to be from schools S13, S15, S18, S36 and S56. Yet, other teachers in the schools reported giving homework after every lesson. This would indicate that the frequency of assigning of homework is more of an individual teacher characteristic, than a school one.

It was also found that, apparently, students do not mind the frequency of homework (after every lesson) as they believe practice is important. What they were not happy with was the amount of homework, as evidenced by the so many extra comments on the amount of homework, and response to a statement

on amount of homework on the attitude scale. (60% expressed dissatisfaction with the amount of homework).

On perceived homework difficulty, more than half (59%) or 1040 students responded that they usually found assigned homework difficult. A higher percentage of girls (61% of 895) than boys (57% of 872) seemed to perceive mathematics homework to be difficult. However, looked at from another angle, the significant number of students who still viewed mathematics homework as manageable (39% of the girls and 43% of the boys) is encouraging. Students in Form 2 who perceived homework as easy or okey were 46.4 % (415) for day scholars and 50 % (472) for boarders. In Form 4, 35.9% day scholars (412) and 30.9% (461) boarders saw the homework as easy or okey. In both cases, more Form 2's (about half) than Form 4's (about a third) perceived the homework as manageable, regardless of their residential status. More (66.6% of 877) Form 4 students than Form 2's (51.2% of 890) viewed homework assigned as difficult. About the same proportions of boarders (59%, n=821) and day scholars (51% of 933) viewed homework as difficult.

What did the students do in case of difficult homework? The majority of students reported that they asked for help from teachers and friends. One, however, also notes a small number of students who admitted that they copied their classmates work, and this number increased from Form 2 to Form 4. More day scholars (10.3%) than boarders (7.3%) copied homework from their friends. Copying of homework to beat difficult homework was mentioned in 42 schools in the study. However in many of the schools only one or two students in a form

admitted to copying. Schools where more than 5 students admitted to copying are S20, 24, 30,31,33,40,44, and 49. Though these are a very small number, one suspects that the number of students who actually copy is bigger. Some students talked of the problem of copying in mathematics homework being common, in 'other comments on mathematics homework' without saying whether they did copy themselves. Why do students copy? Too much homework especially when performed under threat of punishment is likely to provide the right motivation for copying. Two comments, among many that the students gave, in response to this question point at the answer from their perspective:

> *Teachers should avoid overworking students to avoid copying from friends. (Girl, 30: 2-12)*

> *mathematics homework can only benefit the student once he/she realises its importance. Students when loaded with a lot of homework copy from friends, a habit that once started is hard to break. (me being a witness to that earlier). Maths homework is important especially when given in view of helping the student practice (Boy, 48:4-4)*

Table 4.3 below summarises the information about student actions when looked at from the class/gender perspective.

Table 4.3
What students do when homework is difficult (%)

Class	gender	copy	ignore	ask	guess
F2	boys n = 429	6.4	2.5	87.8	1.8
	Girls n = 444	6	3.1	86.6	3.3
F4	Boys n = 421	8.1	3.5	83.6	2.1
	Girls n = 440	9.4	4.3	82.7	2.2

Source: survey

One notes that the percentages of girls and boys in the various categories are comparable. However, although the percentages are low, it is interesting to note that the percentage of girls who guessed to complete homework in Form 2 is about double that of boys. This guessing might mean that girls just finished the homework anyhow, just to finish. The researcher has this suspicion since research quoted elsewhere indicates that boys are more likely to guess (intelligent hypothesising in problem solving) than girls. Of the 1496 students who responded to this question 73%, 18.9% and 3.9% consulted friends, teachers and parents respectively. Students who didn't usually ask for help were found to decrease for both girls and boys in the two classes. For those who asked, the help is mainly got from colleagues in their school. Relatively, Form 4's seem to ask help more from friends and in so doing decrease their dependence on teachers and parents.

The Table 4.4 below shows the responses to the question "Who helps in case of difficult homework?"

Table 4.4

Persons who help in difficult homework by class/gender (%)

class	gender	Parents	teachers	friends
Form 2	Boys n = 341	4.9	16.9	71.1
	Girls n = 357	6.7	24.3	65.2
Form 4	Boys n = 359	2.4	17.9	77.2
	Girls n = 376	1.8	16.4	78.2

Source: survey

Girls in Form 2 seem to have relied on teachers more than boys, and relied less on peers than boys. In Form 4, the percentages of boys and girls are comparable. Note, however, that the percentage of boys in Form 2 and 4 who asked the teacher for assistance seems to remain unchanged while the percentage of girls who asked the teacher for help drops significantly.

The reader may note the different percentages for day scholar boys and girls in Table 4.5; in whom they asked for help. One also notes that only about a quarter of the students consulted the teacher when faced by difficult homework.

Table 4.5
Students' help in case of difficult homework by gender and boarding status (%)

Residence	gender	Helper		
		Parents	teacher	friends
Day scholars	Boys n=412	4.2	20.7	67.8
	Girls n=425	5.9	24.3	63.6
Boarders	boys n= 466	-	14.9	79.1
	Girls n=480	-	14.7	78.5

Source: survey

A close study of the patterns in individual schools also showed that Form 2 students especially sought help from the teacher. No Form 4 student in schools S1, 20, 23, 26, 31, 35, asked for help from the teacher. It is puzzling to find that in schools where pupils reported more punishment, more pupils also sought help on homework from the teacher. One explanation is that some pupils may have been trained (or learned) to be independent and confident in homework while other students might wish to attract teacher attention through asking

questions related to homework. In the classroom observations some six instances were of students were noted attempting to forestall teachers demand on homework by asking questions about homework. Comments given in this study seem to indicate that teachers were perceived by students to be impatient with the low achieving students or those who had difficulty in mathematics.

Day scholars, who usually dispersed from school after lessons, may have been particularly disadvantaged. They scattered away from their friends and may have been limited in the consultation they would get from the easily accessible neighbour(s). They would be at a disadvantage because the friends were not around and the teacher didn't seem to be as accessible as one would suppose. In towns the problem is likely to be exacerbated since houses of fellow students are scattered over the suburb or even in different suburbs, and where culture may discourage 'unnecessary' visitors in the spirit of privacy. In such a case, the pupil is likely to be discouraged, spend time practising errors or even feel frustrated, all with negative consequences in achievement. Table 4.5 above shows that the percentages for people chosen to help were different for day scholars but similar for boarders. Day scholar girls were less likely to get help from friends, especially if homework was done in the evenings. Girls are less likely to be allowed out into the night, possibly due to the extra protection that is usually accorded girls in the African culture.

Some students especially in day schools got help from parents with more girls getting such help, but decreasing from Form 2 to 4, to about a half and one

third. We may note the relatively higher percentage of students in Form 2 who received help from parents in homework compared to Form 4's.This is likely to motivate such students to learn mathematics. The percentages of students who received parental help in homework got lower at Form 4 as possibly the content became more technical for the parent, and as the student got more independent. Another interesting observation is the fact that boarders seem to get help more from friends (79%), while a higher percentage of day scholars gets help from the mathematics teacher(s). Some 307 students gave a second choice, and when that is taken into consideration the percentage of students who consult friends, teachers and parents add to 74.6%, 33.6% and 5.5 % respectively. This compares well with the figures already discussed.

Where is homework usually done? Of the 1748 students who answered this question, 70.3 %, 12.7%, and 13% reported that they usually do their homework in class, sitting room and /or in a bedroom room at home. The class is likely to be free of distractions, except in poorly disciplined schools, and more comfortable too. The researcher observed some relatively high noise levels in class, (that is inconsistent with serious study) in some of the schools visited. Fortunately, 92% of boarders and about 45% of day scholars used the class as the place where they usually did their mathematics homework. Only 44 % of girls and 47.1 % of boy day scholars did their homework in class in the school, while 27% and 20% of girls and boys respectively did homework in the sitting room. The percentages for boys and girls who did their homework in a bedroom/private room are 26.7% and 25.7% respectively. Relatively fewer girls

than boys were left in class to finish homework after school, possibly because they were expected home on time, and were more likely to be assigned other household chores like looking after younger siblings or helping in the kitchen. Such a girl student could be punished for not completing homework but yet she was the one more groomed to be a responsible member of the society.

The sitting room in a residential house is likely to be a more distracting environment – the television is there, and other members of the family use it as a social room. The bedroom has fewer distractions, but it is likely to be shared by another family member and possibly lack in necessary furniture. Some students may not have a study desk in the bedroom and resort to doing homework on the bed. The situation for boys is likely to be different, especially in the rural areas where boys have out huts, which nevertheless may be shared by other boys in the family. The work output of a boy intending to do homework might be influenced by the work ethic of the other occupants of the hut. For boys, this might also make the problem of asking for help from friends in case of difficult homework easier.

If the responses of some 350 students who gave a second choice are considered, class would have 71.3%, sitting room 17.3%, and bedroom/private room 19.6%. These proportions are not much different from the case discussed.

Students were also asked if their teacher minded if homework was completed or not. The percentage of students who thought the teacher did not mind was 16%,

but this seems to increase from Form 2 to 4 from 13% to about 20%. Whereas boys and girls in Form 4 had the same percentage (19.7%), girls in Form 2 are 5% points higher than the boys (15.3% and 10.2%). Why should more Form 2 girls than boys have thought that teachers did not mind completion of homework? Perhaps teachers were more lenient to younger girls, (possibly the teacher seeing the girls innocence in non- completion) or more girls than boys in Form 2 simply did not complete homework.

When do students prefer to do their homework? Table 4.6 provides a synopsis of the responses. Generally, the early mornings seemed to be a preferable time for students (over 50%) to do homework. The percentages of students who preferred to do homework in the morning are higher for the boarders than day scholars, and for girls more than boys regardless of their residential status. Day school girls are more likely to be involved in household chores in the evening and be very tired at the end of the day, preferring to study, do homework, early in the morning. Relatively more day school boys than girls may have studied in the evening because they had relatively fewer responsibilities in the evenings. Some boarding schools especially boys schools allow boys to stay on after the compulsory prep at about 10 p.m. In mixed boarding schools it was noted that boys were likely to have more prep time in the evening since girls were asked to leave for their dormitories about thirty minutes before the boys did, ostensibly to prevent them from mingling mischievously with the boys. Working on homework after prep for both boys and girls in such schools seems more unlikely for the same reason of caution.

Table 4.6
Students preferred times for homework (% of students)

Group	gender	Morning	evening/night
Day scholars	boys n=385	53.1	41.1
	Girls n=408	60.1	36.8
Boarders	Boys n=445	57.5	39.6
	Girls n=447	66.1	29.8

Source: survey

Relatively a higher percentage of day scholars than boarders seemed to prefer doing their homework in the evening/ night it was assigned. Students who do homework in the evening might remember what was taught in class more readily, but they are likely to lack concentration due to tiredness. Should they require help from the neighbour students, the time may also present problems especially for the girls. Some day schools were reported to let or require their students to stay on after lesson time about (4.00 p.m.) to do their own prep. This would give day school students an opportunity to complete homework in a convenient environment. These preferred times for doing homework might, however, be disrupted if enthusiastic teachers come to class during such times to cover some topic.

The students' perception of why other students do well in mathematics was an indirect way of finding out the students' attributions for success in mathematics. The responses of the students to this question were clustered around two main

categories (76%) and two minor (17.4%) categories (all making 93.4% of the responses) as shown in the table 4.7 below. All included effort, especially qualified with some external factor in the main categories. All the other categories had a few respondents each (about 1%), and accounted for only 6.6% of the respondents. Most students (94.3%) seemed to realise the value of hard work by choosing a combination of factors that included effort. Schools are known to keep reminding their students often enough of the importance of hard work. However, the 'teacher and hard work' category was the most preferred regardless of how the data was split for analysis.

Table 4.7
Students attributions for success in mathematics given in percentage

attribution	N	%
Teacher + effort	722	41.8
Intelligence + effort	592	34.2
Effort only	166	9.6
Facilities + effort	135	7.8

Source: survey

The order in each group was 'teacher + hard work' (about 40 %), 'intelligence + hard work' (about 30%), 'Hard work only' (about 10%), and 'facilities and hard work' (about 10%). This may among other things point to the importance accorded to good mathematics teachers. Perhaps the qualities of a good mathematics teacher may be summarised by some recurrent comments students wrote in the study, a few of which are quoted here.

> *a maths teacher should not be harsh, boring, lazy. Books should be marked after every lesson. Also a maths teacher should explain until all students understand. A teacher should not give homework from a topic she/he hasn't taught. [Girl, 29:2-1]*

> *teachers should always try and mark each pupils work individually and correct their mistakes. This will bring better performance in their students. [Boy, 54:4-3]*

> *We should be given teachers of our choice who are loving, serious, and hard working. Lazy teachers contribute to students' failure. [Girl, 36:4-17]*

Form 2 students, especially boarders, had the highest percentage for 'teacher + hard work' (44.5%) while the Form 2 girls have a higher percentage of 'intelligence and hard work'. Perhaps we may expect Form 2 students to believe that they are more clever than Form 4 's if one equates the number of homework problems got right with cleverness. For both Form 2 and 4, day scholars had the higher % for 'effort only' (13.6% and 9.3%).

In Table 4.8 about here the perspective is changed from class/residence to gender /residence. Note that the difference in percentage between boarders and day scholars in the first two categories are wider for boys than for girls. Girls have relatively higher percentages than boys in the category of 'intelligence and hard work' while boys have higher percentages in the 'teacher and hard work' category. Why do day scholars have a higher percentage for 'hard work only' than boarders, and about double for girl day scholars compared to girl boarders?

Table 4.8

Attribution for success in mathematics by gender/boarding status (%)

	Boys		girls	
Attribution	Day	boarder	day	boarder
Intelligence + hard work	28.5	32.2	38.3	38.2
Teacher and hard work	42.8	43.5	37.6	42.7
Hard work only	10.8	9	12	6.5

Source:survey

Perhaps students associated the importance of hard work with the extra amount of work they put into their studies to beat the odds in their lives. That is, students who thought that they struggled more (work harder) than colleagues were more likely to associate success with own effort only.

Students were also asked if textbooks should contain answers to homework they are assigned. Students who like mathematics are more likely to study mathematics on their own besides homework, or they may want to know how well they are doing as they do their homework. Generally, 70.6 % of the students answered in the affirmative. Of students who thought textbooks should not have answers, the percentage of girls was more than that of boys and for the same class, the percentage of day scholars appears higher than that of boarders. This may support the observation in Cockcroft (1982:par212) that girls require more discussion in learning mathematics than boys. Girls may perhaps not

require textbooks to have answers because that is likely to deny them the opportunity to discuss the homework answers with their teacher.

The percentage of Form 2's who think textbooks should not have answers is higher than Form 4's. It does not look plausible that Form 2 students did not like to do their own mathematics work. Therefore, one would think that teachers marked their work or gave them answers to mark for themselves. Such students would have no need for the answers. Another likely explanation is that the Form 2's actually required more teacher (feedback) attention, and approval in line with their age. Form 4 students were more likely to do their own practice in preparation for mocks and the KCSE, and were likely to need such answers for revision. Some students gave the reason why textbooks should not have answers as that it encourages cheating in homework. It may seem that such cheating students did not appreciate the importance of homework. There is room for more checking of students' work by teachers, in line with what they preach; that the method followed to arrive at an answer is more important than the answer itself.

When the group was split by class and gender, the percentages were as follows for the 'textbooks should not have answers' category: 38% for both girls and boys in Form 2, and 14% and 27% for boys and girls in Form 4. One wonders why the value for form 4 boys appears extraordinarily low in comparison to other groups. 86% of the boys wanted their mathematics textbooks to have answers. This may mean that the form 4 boys did more own practice than the

other groups and required answers for such practice. It could also mean that they required or received less of the teachers marking and thus checked their own homework or did more extra practice in their study of mathematics. From the classroom observation of a few pupils' mathematics exercise books, it would seem that Form 4 students marked their own homework often.

Day scholars' percentage for the 'should not have' was higher than that of boarders (day scholars Form 2, 41.1%; Form 4, 21.5 %; boarders Form 2, 35.3%; and Form 4, 19.9%). This may be related to the students' ability (performance) in mathematics since the test scores and KCSE mathematics grades seem related with the boarding status ($r = 0.216$, $N = 1633$: 0.240, $N = 770$: both significant at the 0.01 levels).

Do teachers mind whether homework is completed or not? This question aimed at finding out whether students believed that their teachers considered it important for homework to be completed. The teacher may think that he/she is strict whereas students consider him /her lenient and vice versa. Most students (83.8%, n= 1766) accepted that the teacher would mind if homework was not completed. One also notes the 16.2 % who thought their teachers did not mind. To take a closer look, the information was looked at by dividing it by class and /residential status. The figures for 'no' are 8.7%, 16.6%. 22.3%, 17.2% for Form 2 day, Form 2 boarders, Form 4 day, and Form 4 boarders respectively.

It is noted that the figure for Form 2 day scholars is unusually low. This may be contributed by boys since the Form 2 boys percentage (10.1 %) is lower than

average compared with Form 2 girls (15.3%), Form 4 girls (19.6%), and Form 4 boys (19.7 %). One notes that Form 4 boys and girls have the same percent for whether the teacher minds completion of homework, whereas Form 2 boys and girls differ. This may be either because boys in Form 2 took mathematics homework seriously more than girls did or, teachers actually were more lenient on girls who did not complete homework.

After a careful observation of the data, it was noted that the percentage of students who reported that their teacher did not mind completion was not related to their performance in mathematics. It was seen that the critical quality was whether their homework was checked. Of students who said that the teacher minds completion, 90% reported that their work was checked regularly, while only 46 % of students who thought that their teacher doesn't mind completion had their work checked regularly. It was observed earlier that more boys than girls, and more Form 2 than Form 4 respondents reported their work as being marked regularly. This may explain why the percentages for form four saying 'no' is higher than Form 2's.

The study also wanted to understand factors that motivate students to complete homework. Among the choices were 'own personal goals' to mean that their own personal goals motivate them regardless of the type of homework or other external persons. Among the choices given a big group (752) 43.6%) of students chose 'own goals', (484) 28% chose 'love of maths' while (198) 11.5%

'type of homework' and 12.1% (208) the 'teacher pressure'. The data was split by gender, class, and residential status for a closer look.

Parents (though a few of them) helped pupils (especially day scholars) complete homework perhaps by encouragement or by actually offering help when students were 'stuck'. This motivation is especially cited by more girls than boys and by more Form 2's than Form 4's. On teacher as a motivating factor, less Form 2 girls than boys cited this motivation. Perhaps this is consistent with the finding that more girls than boys thought that their mathematics teacher did not mind completion, or to the fact that fewer girls than boys got their work checked. The Form Four boarders boys show a higher percentage (15.5%, n=198) than day scholars (10.1%, n=226). This may be related to the students' perception of anticipated teacher action and marking.

On 'love of mathematics' as a motivating factor to complete homework, Form 4 girls especially day scholar girls and Form 4-day scholars seem to have comparatively lower values than average. Actually Form 4 day scholar girls have the lowest value (21.5%, n=209) in the groups showing that more such girls than boys may not have cared much about mathematics. On the 'type of homework' motivating students to complete, there is a bigger number of day scholars than boarders. This also may have implications for the design of homework in that lower achievers complete homework when it seems within their ability. It seems there is a relationship between the KCSE grade and the

Table 4.9
'Love of mathematics' (%) and KCSE mathematics performance

Grade	1		2	3	4		5
N	231		133	99	40		64
%	20.3		21.8	24.2	22.5		40.6
continued							
Grade	6	7	8	9	10	11	12
N	48	41	28	20	30	22	56
(%)	29.8	36.5	53.6	60	53.3	59	63.8

Source: survey

Looking at the table, the percentage of students motivated by 'love of maths' seems to increase in three stages from grade 1 (E) to grade 3 (D), 6 (C) to 9 (B) and 10(B+) to 12 (A-). There seems to be a minimum point at grade 4 where the % of students citing love of mathematics falls, and then rises unusually at grade 5. The fluctuations at grade 4 and 5 might be a reflection of the grading of the KCSE examination, but from grade 8 (B-) one sees a pattern where more than 50 % of students cited 'love of mathematics' as a motivating factor to complete homework. In other words, most students who scored highly in the KCSE liked mathematics, and this motivates them to complete homework. This is a kind of internal motivation rather akin to self-motivation in the social cognitive theory. The good students' love of mathematics, perhaps, caused them to do homework which they did well (it likely being set for the average students) and expected to feel good for getting problems right which other students got wrong.

On own goals, values for day scholar boys, Form 2 boys and Form 2 day scholars were unusually lower than the average, especially Form 2 day scholar boys (34.7%, n= 202). This might indicate that Form 2 boy day scholars might not be so clear about their goal, aspirations in life. One wonders why this is so, but this question cannot be resolved by this study and may require other research attention.

One measure of how students are in daily mathematics including mathematics is to ask their teachers. Another, even better way is to ask the student how good they feel they are in mathematics, because that may summarise their experiences with mathematics, with self concept, and teachers expectations. It was thought that students used the homework they did every day, and the marks they got in class tests to form an opinion of how good they were in mathematics. To ask the students how good they are in mathematics was to ask them to say how successful they find themselves in mathematics homework and in other mathematics activities.

About half (57 %) of the students rated themselves average, 20.6% as poor, 16.6% as good, and 5.6% as very good. If the 'very good' are added to 'good', we have a bigger 'good' group with 22.2% of the students, which compares well with the 21% for 'poor'. From table 4.10 below, we note that Form 2 boys have the highest percentage for 'average', and that the total for boys' 'average' and 'good' is higher than that of the for girls. More girls than boys rated themselves poor in mathematics.

Table 4.10
Pupils self-rating of 'goodness' in mathematics class/gender (%)

Self rating	Form 2		Form 4	
	Boys	girls	boys	girls
Poor	14	15.2	24.5	28.5
Average	60.6	58.9	54.5	54.1
Good	18.1	22.1	15.9	10.9
Very good	7.3	3.8	5.1	6.5

Source:survey

Percentages for the 'poor' category are higher for Form 4 than for Form 2. Form 2 respondents were likely to get more problems right in homework, consider homework easier as mentioned before and thus they were more likely to rate themselves 'average' than 'poor'. One also sees that the Form 2's again have a higher percentage for 'good' and 'very good' while Form 4's have higher % of the 'poor' rating. It seems that pupils self-rating in mathematics might go down as pupils move to Form 4, because as they encounter more difficult problems in homework, they lose confidence in their ability in mathematics.

Form 4 respondents who might have had more experience with failure or success, and since they found the mathematics content becoming harder, they were more likely to rate themselves as 'poor'. Like alluded to earlier, the self-labelling is also likely to be associated with what the teacher and other students said about an individuals ability in mathematics. If the teacher continually blasts you as foolish, you are likely to believe so. However, one may visualise two

groups of students: one of students who were actually poor in mathematics (absolute), and another of those who considered themselves poor though they were not actually poor (relative). Those who liked mathematics, tried, but fail may have labelled themselves average even when they were actually 'poor'.

To take a closer look the information was looked at from the class scores and KCSE grades. Students were divided, using their test scores, into four groups by percentiles (25^{th}, 50^{th}, and 75th) for each of Form 4 and Form 2. It was found that as the achievement level increased, the percentage of students in the 'poor' and 'average' self- rating decreased, while that of 'good' and 'very good' rating increased. This indicates that there is some relationship between the students self-rating and their actual achievement in teacher made tests. Table 4.11 summarises the information.

Table 4.11
Students self-rating of ability in mathematics by class and test scores. (%)

Grp	Form 2 (n=889)					Form 4 (n=882)				
	poor	aver	good	vg	No.	poor	aver	good	vg	No.
1	26.8	62.3	8.7	2.2	139	44.8	48.3	2.9	4.1	173
2	17.1	65.7	13.6	3.6	140	36.4	56.3	4	3.4	176
3	9.2	59.9	25.4	5.6	142	17.3	68.5	11.1	3.1	162
4	3.3	46.4	41.8	8.5	153	6.5	47.6	35.3	10.6	170

Source: survey

The analysis also showed that either deliberately or otherwise some students overestimated or under estimated how good they are. Among the actually 'very

good' students there was a number of students who described themselves as 'poor' and 'average' (about 10%), and among those actually poor (from the test scores), there was a number (about 10%) of students who described themselves as 'good' and 'very good'. Some 'very good' students had a tendency to underrate themselves while the 'poor' tended to over-rate themselves.

But why would this be? It may seem that poor students shied away from the 'poor' tag while the good students knew how much they still had to learn thus underestimating their ability. Or is it that the students had not had the opportunity to learn to form realistic assessments of their ability in mathematics? Sifuna (1989:277) found similar reactions when he asked teachers to rate themselves. He reported a tendency for the academically lower teachers to overate (high) themselves while the better teachers underrated themselves (weak and average).

At least from their complaints about discouraging remarks in homework, students did not feel happy when the teacher labelled them 'poor' or 'weak' in their homework. The undesirability of 'weak', 'poor' comments is discussed elsewhere. Another interesting thing is that for some few students two answers were given, for example, 'sometimes poor sometimes average' showing that perhaps the self rating may not be very stable and might depend on feedback pupils get in homework, and class work. It was noted that in some few schools the correlation between self-rating and achievement was low. A possible explanation is that self-rating of how good students are in mathematics is

malleable and could be shaped by the teacher for good or for worse. If this were true, it may have implications on how teachers award marks in mathematics, comments they make arising from students performance of homework or the difficulty level of the homework and tests they set for students.

Students self rating is significantly related to their test scores ($r = 0.39$, $N=1632$, $sigf = 0.000$) and to KCSE performance ($r = 0.419$, $N = 838$, $sigf = 0.000$). An improved self concept (self rating) especially in daily in mathematics might lead to better performance but this cannot be said conclusively from the data in this study.

Generally, about half of the students spent up to one hour on mathematics homework assigned in the day. The higher the percentage of time up to one hour spent in homework, the lower the percentage of time spent beyond one hour. Form 2 boarders have the highest percentage on time spent up to one hour (62%) meaning that many of them took a relatively short time to complete homework. More than a half of the Form 4-day scholars (57%) took more than an hour on homework. The proportion of Form 4 who took two hours on homework is bigger than for form 2's, while the proportion of Form 2's who took about 30 minutes to complete homework is higher than that of Form 4's. Perhaps this is because students were given more homework in Form 4 than in Form 2, or because the homework assigned became increasingly harder.

Relatively, how much time do students take in homework and own practice? The table 4.12 about here summarises the findings. More Form 4 than Form 2 respondents admitted to spending little or no time on homework or own mathematics practice. In both Forms, boys did own practice more than the girls. Contrary to what we would expect, the proportion of Form 4 girls who did own practice in mathematics is less than that of Form 2 girls. It is sad to note that a relatively high percentage (35% in Form 2 and 45% in Form 4) of students admit to doing little or no mathematics work.

Table 4.12
Relative time spent on mathematics by class and gender (% cases)

relative time spent on mathematics	Form 2		Form 4	
	Boys N=436	Girls N=439	Boys N=426	Girls N=440
No time in homework or own practice	35.3	37.8	43.9	45.5
More homework than own practice	3.7	9.8	4.7	5
Same homework and own practice	25.5	18.5	14.8	19.8
More own practice than homework	35.6	33.9	36.6	29.8

Source: survey

This may indicate that some students are already disenchanted with mathematics and mathematics homework. This sounds like the familiar statement from the KNEC that some students seem to have dropped mathematics. Students may fail to do mathematics work because it is too difficult for them or because they do not understand fully the implications of not taking mathematics seriously.

Some students do not finish homework. Rather than ask students why they did not complete homework, they were asked why other students do not complete homework. The question was set to ask about others, hoping for a more sincere answer. So, "why don't some students finish homework given?" Among the popular answers given.were that: students were lazy (47 %), the homework was too much (39 %), the homework was difficult (31 %), students had a negative attitude towards mathematics (7 %), and the fact that the teacher did not mind completion (6 %). It is assumed that those who gave 'laziness' as a factor would be describing other students, and not themselves, and therefore that most likely they themselves (47%) completed assigned homework. If they did not finish homework students were more likely to give another answer but laziness. In fact, it was noted that more weak students than good ones (63% and 40% respectively) attributed non-completion of mathematics homework to too much work and difficulty, while more 'good' students (more likely to complete) than 'poor' ones attributed it to laziness as shown in Table 4.13 below.

Table 4.13
Attributions for non-completion of homework by self-rating (%)

reason	Poor (%) (n=332)	Average (%) (n=903)	Good (%) (n=363)
Lot of work	34.5	31.6	26.6
Attitudes, laziness	29.8	46.2	54.8
Teacher does not mind	5.8	4.1	2.7
Difficulty	28.9	15.8	13.2

Source: survey

We should, however, note that altogether 70% of the students thought that homework difficulty and homework amount are reasons for non-completion of mathematics homework assigned. The reasons given seem to depend on the residential status and the class of the students, but not on the gender. (residence: $\chi^2 = 23.289$,df 5, Cramer's V =0.121, sigf. 0.000 / class: $\chi^2 = 31.566$, df 5 , Cramers V= 0.14, sigf. 0.000)

From other comments by the students it is clear that in many classes, the amount of homework was considered rather too much or on the higher side. Comments about the quantity of homework were very frequent with the following two as typical examples.

> *Give us about 5 problems (not 30 like we are given) so that you can finish quickly, practise and reread what you did. Also a lot of homework in maths consumes a lot of time and discourages students who are unable to do hence they copy from friends or guess (cook') so as to avoid bad comments from our teacher and punishment" (Girl, 50: 4-2)*

> *"Personally, I don't think that a lot of homework helps much since you may be given a lot, yet you did not understand thus it may even discourage you. Therefore a little homework perfectly done and lots of personal practice is what helps students to pass maths" (boy, 42:2-8)*

Students also complained of being given mathematics homework for which they felt they are not ready. Unfortunately the teacher in giving homework believes that students have understood. The following comments illustrate the point:

> *(i) there is no need of giving maths homework yet the teacher doesn't teach. Maths homework should not be given for the sake of giving. It should be given for the purpose either to understand the topic or to practise on it. (boy ,49:2-18)*

(ii)Teachers should stop assuming that we are supposed to know everything since we are in Form 4 (girl, 50:4-3)

(iii)Mathematics homework is terrible unless one is sure of what he is doing. We actually need proper explanations from our teachers. Most important, students should be encouraged even if they fail (boy, 49:4-6)

Some students preferred that teachers ensure that they understood before being assigned homework. The 'explanation' method of teaching observed in many sample schools seemed to take a lot of lesson time leaving students with little or no practice in learnt skills before being assigned homework

Some smaller group (106 students) saw non-completion of homework as related to whether the teacher minded or not. Teachers who were perceived as not minding completion were likely to just assign homework and continue in the next lesson as if it had not been assigned, without checking if it was done or not. Students who took time to complete assigned homework complained that they were discouraged by such a situation. Additionally teachers may also need to take time to understand why students do not complete homework. Some students reported that they were not able to complete homework because they did not have facilities e.g. proper room, study lamp/kerosene, or there were other domestic problems at home, interruptions by teachers during prep or even homework from other teachers. The teacher who considers student difficulties when assigning homework is more likely to encourage students towards ownership of homework (Spadano, 1996).

Students were asked to explain what their teacher does when they don't

complete their homework. This question attempted to probe teacher reactions and the kind of pressure they exert on their students because of homework. The typical responses are summarised in the table 4.14 below:

Table 4.14
Anticipated teacher reaction to non-completion of homework (% of students).

Action	**Form 2** N=875	**Form 4** N=871)
Ignored	11.3	19.6
Given more homework	5.5	5.5
Punished	46.1	28.7
Sent out	22.1	17.8
Reprimanded	3	7.6
Forced to complete	30.4	40.8

Source: survey

The percentages add up to over 100 % because some students chose a second response. This would mean that students expect their teacher to react in more than one characteristic way to non-completion of mathematics homework. The students' second choices, however, do not affect the rank order for the teacher reactions anticipated by the groups. The most prevalent are forced to complete, punishment and being sent out of class.

One notes the big variations between the two groups in perceived teacher actions in case of non-completion of homework. For example more Form 2 's than Form 4's expected to be punished for non completion of homework while

more Form 4's expected the teacher to ignore non completion or to force them to complete. The 'forced to complete homework' was explained to mean that the teacher asked students to take time in the mathematics lesson to complete the homework. In some cases the mathematics teacher would go back to relax in the staff room as 'rogue' students completed the homework. In some schools the researcher was offered to administer the research questionnaire in a class whose students were left unattended because they "had homework to do".

Almost a fifth of students expected to be sent out of class for non-completion of mathematics homework. From the researcher's observation such students would be asked to get out and kneel, sit on the dusty floor, stand outside the class or just get out of sight! Students would be required to complete the homework while outside or just get out. We may suspect some such students just hid away some other favourite book to read while outside. While some students expected to be sent out for non- completion of homework, some students expected the teacher to ignore. Actually it was observed in some two classes that the teacher tended to tone down on completion of homework when specific (good?) students explained that they were not able to complete.

Sending pupils out seemed to be a common way of dealing with non-completion of homework, being mentioned in 35 (about 70%) schools in the study. From classroom observation it seemed that there were some students who were more likely to be sent out than others. The mathematics teacher was more likely to ask for an explanation why homework was not completed from

the better students while punishing or sending out the weaker students. More students were sent out in some schools, especially in S12, S15, S28, S34, S35 and S50. The researcher heard that the principals in such schools were usually aware of such methods but were reluctant to interfere in 'trained' teachers' ways of dealing with errant students, so as not to be accused of 'undermining discipline in the school'. Two principals who taught mathematics were themselves observed to send students for non-completion of homework. Griffin (1996) from his experience in Starehe Boys Centre says sending out students is counterproductive.

Whether students are punished in class, sent out of class, or forced to complete homework immediately in class, a lot of time may be spent on the administration (assigning, checking, and dealing with non-completion, review) of homework rather than on learning mathematics. These actions may not be very beneficial to the student who is failing in mathematics.

Students were also asked to state what facilities restricted their doing of homework well. The most common answers are listed in Table 4.15 about here. Some 397 students gave a second answer and these have been included in the calculations. One sees that books (reference and text) are among the factors that hindered proper performance of mathematics homework. Compared to boarders, day scholars appear disadvantaged on textbooks, lighting (as basic as a lamp and kerosene), writing materials and room. Books still are a major

resource for learning mathematics in the Kenyan situation, but it was noted in sample classes that there were not enough for each student to have their own.

Table 4.15
Factors restricting doing of homework (%)

Restriction	Form 2		Form 4	
	Day (401)	Boarder (439)	Day (405)	Boarder (407)
Reference books	33.9	40.1	36.3	39.1
Textbooks	33.4	30.1	25.4	22.6
Light	1.4	3.7	4.4	2.4
Writing material	4.7	3.9	3.7	3.2
Study guide	33.9	39.9	43.5	49.5
Room for study	11.5	5	9.1	4.2

Source: survey

In the majority of the better performing boarding and day schools, mathematics textbooks were provided in the school although these would still be shared. Schools S20, S40, S42, S43, S45, and S48 had no limitation of textbooks reported. It is also instructive to note that among the better mathematics performing schools, few students mentioned the problem of textbooks. In other schools, especially the lower performing ones, students would be required to buy their own textbooks. Whereas boarders could easily share textbooks, its more difficult to borrow or share a textbook in a day school because of distances between homes, and also because some parents may discourage such sharing. A national project to supply textbooks to secondary schools especially

in day schools, (c.f. Republic of Kenya, 2001: 136 notes poor students disadvantage who cannot afford to pay for books.) might help. The lower percentage for textbooks and a higher percentage for reference books noted in the table 4.14 above may describe the general situation that boarding schools had a better capital base that could be used to purchase textbooks.

One other observation is that Form 4 students seemed to have more books than the Form 2 students did. Whether this was deliberate or not is clear. Parents and school administrators are likely to be more generous with the more mature students because the students can demand them or deserve the textbooks for revision. More Form 4's than Form 2's seemed satisfied with the textbooks with a lower percentage (only a quarter) mentioning textbooks as a limitation.

The study guide was also mentioned by a big number (587) of students. The Form 4 's have a higher percentage for this response perhaps in line with the finding earlier that they find homework more difficult than Form 2's. It was perhaps not clear whether a human guide or a book guide was required, but the response served to indicate that students encounter problems in mathematics homework, which could be alleviated by study guidance.

Note that although the percentages for lighting as a problem are low, the figures for day scholars are double those of the boarders. Boarders may have mentioned lighting as a problem because around the time of the study there was power rationing in the country. The problem of lighting is likely to be more serious in

the rural areas where the lamp may be lacking or even kerosene to run the lamp during homework.

The number of students that cited room as a restriction was sizeable (122) and the teacher might put this into consideration in assigning homework especially in day schools. Students who cite room as a problem are divided about equally between boys and girls (56/66). One would guess that girls in Kenya are particularly disadvantaged in that they do not have own huts like boys in rural areas do. But perhaps they do not consider that a problem. Some parents may deal with this problem by taking their daughters to boarding school.

Students who reported that their homework was checked regularly were 84.6 % (n=1742) while 15.4% (268) of students reported that their homework was never marked. This would be a satisfactory state of affairs if some students meant exactly that. However, from other observation and students other comments, it seems that the students included checking the homework themselves as a form of checking homework. Students complained that they often marked their own homework. They may have done this from answers provided at the back of a textbook, or from answers provided by the mathematics teacher in a subsequent mathematics lesson.

More boys reported their work as marked regularly (87%) compared to 82 % of girls. Similarly more Form 2 respondents (87.9%) than Form 4 ones (81.5%) reported their work was marked regularly. Some students complained of their

books not being marked by teachers who seemed to favour some students as the following comment would suggest:

> *Teachers should mark all the books without discrimination and have good attitude towards all students" (form 4 girl, 38.4.4)*

Students were asked what teachers' marking methods they found useful. Most students (about 60%) preferred that in marking homework, teachers' comments be included with the marks or grades. Other categories that seemed to attract some students were just ticks and wrongs (about 15%), a simple marking method. The categories of 'marks only', 'general comments in class', and 'grades only' attracted less than 10% each. This indicates the importance attached to teacher feedback by the students. However, teachers are able to provide valuable comments only when they carefully check the student's homework.

Incidentally, when pupils were asked what would discourage them most in homework, most responses were centered on comments that originate from homework marking. Of the 1112 students (62.4% of student respondents) who answered this question, 69.1% of them said they were discouraged by the teacher comments they got. 25.5% said they did not get discouraging comments while 5.1% said whatever comments teachers gave were for their own (students') good. If we allow for student fear, we may suspect that those who were unwilling to answer the question were likely to lean towards the discouraged group. Incidentally, this was an open-ended question, so the responses were reflective of the students' strong feelings.

Of those who said something discouraged them in homework, about three-quarters said the remark 'poor' or 'weak' on their homework discouraged them. The students explained their discouragement from the 'poor' and 'weak' related comments using different words as shown by the sample comments below. The comment 'Poor', 'weak', with or without an adjective was considered most discouraging because:

- *It makes me feel depressed because it seems the teacher does not appreciate what I have done.*
- *It makes me feel that I can't do anything and it also undermines your dignity.*
- *It makes a student worry and hate mathematics.*
- *It discourages me from doing mathematics revision.*
- *It makes me look inferior.*
- *I lose the morale to do mathematics.*
- *It makes me feel inferior and discouraged.*
- *You lose the heart of working on because even if you work hard you are going to get the same comment, so one sits back.*
- *It shows that you have no chance of improving, better use 'below average'*
- *It doesn't encourage one to work hard.*
- *It makes me lose hope in mathematics.*
- *It makes me feel ashamed to show someone my book hence I cannot be helped.*
- *It makes me feel discouraged and neglected by the teacher.*
- *It makes you lose hope because may be you had struggled very hard to finish.*
- *Better write 'trial' even if the student gets nothing to encourage them to try next time.*
- *One feels despised in class and shows you that you can never pass.*
- *It shows that the teacher does not appreciate your effort since you may have tried your level best.*

Several students in each school made comments about being discouraged by the comment 'poor'/ 'weak'. Looking at the reactions of students to such a comment on their homework, it seems that mathematics teachers would rather

avoid such discouraging phrases, whatever their intentions. It affects the students' self-concept and their will power to continue trying to learn mathematics.

One also notes that there was some mismatch between the teachers' and students' perceptions on the evaluation of homework. Students seemed to expect the teacher to appreciate the effort expended, for example the time spent on the homework or the 'hard thinking' put in. Teachers, on the other hand, seemed to ignore the effort expended, judge the product, say, how many problems the student got right, and to expect students to understand that accuracy was the ultimate measure of good work.

Incidentally, 14% of the respondents to this question said they were discouraged by the way the homework was marked or not marked. From the comments, it was observed that some teachers just asked students to mark their own work, or when they marked, students did not get adequate feedback on where they went wrong.

Students also mentioned that some teachers discouraged them through comments made in class after homework. Such comments were: 'you need prayers'; 'the problems were self explanatory'; 'wake up'; 'you won't escape an E'; 'no matter how hard you try you will still fail'; 'you cannot make it'; 'you ;will surely fail'; 'use your common sense'; 'the best [students] will remain the

best'; while the rest will remain where they are'; 'you better leave school'; 'think or sink'; 'you came to learn, not to be spoon-fed'.

Perhaps, the teachers used such comments in a bid to prod the class on, to work harder towards success, but those comments were not well received by students, and certainly they are not kind. Some other discouraging comments reported by student such as 'silly', 'stupid', 'foolish', 'lazy', 'hopeless', 'cow', and 'goat' sound a bit peculiar. The comments might be an indication of the teacher's frustration in teaching students who did not seem to grasp the 'basic' concepts quickly, but surely such comments could not help students build positive attitudes towards mathematics. Luckily, reports of the abusive comments were not common, being concentrated in some few low performing schools. It seems also that the negative comments were characteristics of some individual mathematics teachers.

A few students' reactions to such a situation are mentioned here as examples

> *Teachers should stop discouraging and abusing students simply because they are weak. / boy, 28:4-8 /.*
>
> *I think students attitude towards mathematics should be made positive by encouraging them where they feel they are failures and guiding them. They should not undermine or tell students that they cannot make it as this makes one panic and get confused* (Girl, 29:4-8).
>
> *Teachers should not discourage students by writing too many comments in the /exercise/ books* (Boy, 4:4-19).
>
> *Teachers should not discourage students who perform poorly in mathematics homework because they always try their level best and the more they discourage them the more they hate the subject and the*

teacher such that even they cannot concentrate while the teacher is teaching". (Girl, 38-4-9)

Methods that students preferred to be used in marking their homework, are summarised in the table 4.16 about here. Generally, students regardless of their gender, class and boarding status seemed to place the methods in the following order of merit: (i) teacher commenting on difficult problems asked in class, (ii) the teacher marks each students work, (iii) exchanging books as students mark, (iv) students marking their own homework, and finally [and only a few students], (vi) students marking their own work from the textbook.

The interesting thing is that more (about 70% for first choice and second choice) pupils than in other categories preferred the teacher to solve difficult problems on the board to marking their books individually.

One would expect that most students would prefer that their homework be marked individually than listen to a revision in class. One explanation is that the weaker students might have preferred to have their work unmarked to getting discouraging personal comments. In fact, only in the students who rated themselves good was the percentage in the first choice for 'marking by teacher' higher than for 'comment on difficult problems'. Students who cheated on homework would also like it better that their exercise books were not perused through by the teacher. But perhaps commenting on difficult mathematics problems in class was the practical compromise that had been found to work by most teachers.

Table 4.16
Preferred marking methods by class/residence. (%)

Method	Form 2		Form 4	
	Day (n=390)	Boarding (n=447)	Day (n=399)	Boarding (n=444)
Comment on difficult problems	61.8	67.5	64.7	71.9
Teacher marks each student's work	47.8	51.1	47.4	52.5
Exchange books	36.7	53.1	37.6	43.2
Mark own work	26.4	36.4	39.4	39.6
Use textbook answers	4.4	5.4	6.3	6.8

Source: survey

One also notes that only a few students (about 5%) wished to mark their own work from textbook answers as compared to about 35% who mentioned marking own work in class under teacher supervision. This underlines the importance of the class mathematics teacher, perhaps as an authority figure in the class or as a prop for those students who are not confident in their ability in mathematics.

As a further note to the above, it was found that on preference rank 1, two thirds of the students were split equally between the teacher marking and just commenting on difficult problems whereas the other one third were split equally between marking own and exchanged homework. This indicates again the importance of these two methods in providing feedback to students. On rank 2, about two thirds of the students were split between the teacher marking their

books, and commenting on difficult problems with the latter having about two thirds of such students. This would mean that students who ranked 'teacher marking books' first would also rank 'teacher commenting on difficult problems' second and vice versa. It was surprising, however to find that only about a third would rank teacher marking first. This may also indicate that teacher marking is either not expected by a majority of students, or they don't even desire for such marking.

What did students perceive to be the worst thing about homework? Generally, 49.9%, 22.4%, 7.7%, 10.1% and 4 % represent the percentage of sampled students who thought that the worst thing about homework is 'taking too much time/ being too much work', 'working alone', 'proving oneself wrong', 'not rewarding the effort put' and that there was 'nothing wrong' with it respectively. Almost a half of the girls, (and consistently more than boys) felt that there was too much work in homework.

Table 4.17 summarizes the students' responses by their class and boarding status. Percentages for working alone differ for boarders and day scholars. As one can see, the prospect of working alone was more worrisome to the day scholar than to the boarder, and consistently more for the boys than for the girls. This may support the proposition that girls were likely to work at homework and classwork more persistently than boys, especially if the amount was not discouraging.

Table 4.17
Summary of the responses of students on worst thing about homework (%)

Worst thing	Day scholars		boarders		Form2		Form 4	
	Boys 375	Girls 390	Boys 411	Girls 416	Boys 401	Girls 417	Boys 385	Girls 393
Too much work	43.3	49.4	49.9	56.8	43	53.8	50.5	52.3
Working alone	28.9	26.4	18.8	15.8	27.8	22.8	19.8	
Prove me weak	9.5	8.3	9.2	3.9	10.2	7.8	8.3	4.5
Not worth effort	11.6	9.3	10.1	10	10.2	7.1	11.2	12.2
None	2.1	1.2	5.9	6.6	4	3.1	4.1	4.8

Source: survey

The day scholars (perhaps poor performers) also seemed to show their desperation in their circumstances by having higher percentages of students who thought that homework did not reward their effort and that it only proved that one cannot learn mathematics. Students were also shown by contingency tables to differ by gender and residential status (gender: $\chi^2 = 33.937$, df 20, sig. 0.027 and Cramer's V 0.142 / residence: $\chi^2 = 73.669$ df 20, sig. 0.000, Cramer's V 0.209.) on their response to the worst thing about homework.

Table 4.17 further reveals that day scholar girls and boys do not seem to differ in their reported discouragement from homework. However, twice as many boy boarders than girls, and more Form 4 boys than girls were discouraged by homework proving them poor in mathematics. The difference in such perception seems to be especially wide in Form 4 girls and boys. The

percentage for boarding girls is unusually low (3.9%) and requires explanation. Why boarding girls have a percentage about a half of that of other groups on the response that homework can prove them weak in mathematics is interesting. One also notes that the percentage (4.5%) for girls in Form 4 is rather low, being also about a half of the value for the boys. But why would more boys than girls be afraid of being proved weak in mathematics, especially in Form 4? Perhaps mathematics was viewed more as a boys' domain so boys were more embarrassed by failure (especially the supposedly 'better' boarders) in homework than boys. This seems to support Costello (1991) that girls are more surprised by success since they expect to fail in mathematics. This way, when they fail in mathematics homework, girls may not be bothered by the fact as the boys would.

If more boys were likely to be embarrassed by failure in mathematics homework, this was likely to encourage more boys to adopt face saving tactics such as not putting effort and mocking those who put a too serious an effort in mathematics homework. One case in point is likely to support such a view. In a closer look at the schools responses to this item, it was noted that school S7, in which teachers were really pushing their students to achieve in mathematics through daily homework and a 'mathematics hour', students also had the highest percentage of fear of being proved weak by homework. Parenthetically, copying does not seem to be a face saving tactic for such students. The percentages for girls and boys who copy to complete homework are comparable, so students do not copy their friends work to save face but most likely to avoid punishment.

From the 'none' category one can see a relatively bigger group of boarders who valued homework than day scholars. The category of 'none' is a unique answer because it was suggested and added by students themselves. It is noted that more boarders than day scholars, and more girls than boys gave the 'none' response. Possibly, more boarders than day scholars, and more girls than boys were satisfied with the situation in homework.

Students were also asked what they perceived to be the most important thing about homework. Table 4.18 summarises the students' first responses, and when their second response is also considered. The fact that almost a third of the students (523) chose a second category for the most important thing about homework shows that homework in mathematics served more than one purpose to them.

Table 4.18
Percentage of students responses on the most important thing about homework

Importance of homework	1st choice	No.	(1st +2nd choices)
Check how clever in maths	3.9	86	4.9
Learn to work alone	51.8	944	54
Know where I go wrong	33.6	716	51
Help pass KCSE	3.7	109	6.2
Check understanding	4.4	233	13.3
Practice	1.8	150	8.6
Total		1748	129.4

note: % is more than 100% because some respondents chose a second category.

From the data in the study, the two purposes of mathematics homework students perceived to be most important were to give them opportunity in learning to work alone -independent study- (54%) and to provide students with feedback about where they went wrong (revision?) in mathematics (51%). Another 13% of students said that the best thing about homework was that they were able to check their understanding of a topic. One notes that independent work is the most popular whether the first rank only or both ranks are considered. On the whole, therefore, pupils seemed to agree that it is necessary to do homework for the reasons given.

4.4 Students' Other comments

Among the students sampled, 532 students (or 30%) answered an open question on any other comments they wanted to add about mathematics homework. To make that extra comment students must have felt strongly about the issues raised. A number of students, however, gave a clue as to their motivation when they added that they hoped that their comments would be useful in improving the situation in the teaching of mathematics.

In analysing the comments, the research also looked at the motivation of the comments. The comments were considered roughly as (negative) complaints about something that should be addressed in the pupil's situation (e.g. we should be given less homework), neutral making a statement that is not related to the pupils own situation and (positive) encouraging remarks that showed the pupil was hopeful in mathematics. Among these respondents, 373 (71%) were

complaining of some aspect of mathematics teaching and learning in relation to homework. From the many negative remarks about how things should be in mathematics/ homework, one suspects that all is not well. One, however, is encouraged by the 29% who gave some positive remark, expressing hope or giving some advice about how mathematics/ homework should be approached to be successful.

It was also interesting to note that the negative or positive comments were clustered around class groups. That is, students from the same class or school were more likely to have related comments. This would indicate that attitudes in mathematics were more of a group problem than individual phenomenon. To tackle negative attitudes one would, thus, have to tackle the attitude of the group. Two HODs of mathematics in some poor performing schools lamented that it is difficult to change a class' attitude because 'your encouraging comments are likely to be contradicted by the bigger crowd out there in the school'. To tackle the attitude of a class towards mathematics, one may have to tackle the attitude of the school first or as well.

63% of the respondents who volunteered comments made a comment about Mathematics teaching, 16% dwelt on mathematics/homework while 12 % made comments on what students should or should not do in mathematics/homework. Some students felt, for example that mathematics as a subject should be /reduced removed from schools while some felt that it is so important that some more time should be availed for the study of mathematics. Among the 532

respondents 208 gave a second response and this is included in the percentages reported. The categories used are not mutually exclusive; a comment on ignoring individual differences could be categorised as an aspect of poor teaching. The comments could be lumped together to make more inclusive categories but it was thought more information would be obtained when they were segregated. The most frequent themes of the comments were:

(i) That the amount of mathematics homework be reduced (22.2%),

(ii) how mathematics should be taught - qualities of a mathematics teacher, organisation of the class, preparation of students for homework, and pace of instruction. (18%),

(iii) importance of mathematics/homework and the need to take it seriously by both teachers and students(18.%),

(iv) attitudes to mathematics, - difficult/easy, boring/interesting, liking/hating (15.1%)

(v) that mathematics homework should be checked regularly and / or corrected in class, (13.3%),

(vi) that poor performers be respected and considered in mathematics homework (12.8%),

(vii) that teachers encourage and not discourage performance in mathematics homework (8.6%).

(viii) that other sources other than the textbook be used for homework, (3.8%)

(ix) that teachers make themselves approachable (not harsh) and avoid punishment for homework, (7.1%)

Comments on mathematics teaching dwelt mainly on the fact that teachers should take time to explain issues clearly before assigning homework, to repeat an explanation on how a solution was obtained if asked to, and to remember to match their explanation pace to their students understanding. Some few comments also talked about the need for group work in mathematics. Comments that dwelt on how mathematics should be taught, or homework organised, or about the qualities of a good mathematics teacher were placed here.

> *mathematics teachers should not be lazy or favour only the bright students in mathematics. Instead, they should be more close to the weaker students to establish a good mathematics ground for them to ensure good performance in mathematics for ALL the students and not a fraction them. [Girl, 9:4-2]*

> *The teacher should repeat a topic tirelessly when he/she finds that it was poorly performed in homework. The teachers should try and give encouraging comments, like tried, can do better. [girl, 54:2-15]*

> *maths is a good subject but it depends on how your teacher is, whether he is very harsh or relaxed [approachable]. If a teacher does not bother to look [check] homework students take that as an advantage and take maths very lightly. [boy, 55:4-12]*

> *On my side I would say that some teachers think they are so [very] intelligent for teaching students mathematics and are very pretty. They should know that a candle does not lose its light by lighting others. [boy, 33:4-14]*

Comments on individual differences were mainly complaints that teachers seemed to take more time with or to favour the faster students. Some students felt that some other students' homework is marked more often than theirs, or that the mathematics teachers seemed to trust on certain students' ability to understand or complete homework. Comments were categorised here when they

mainly dwelt on differentiation of students. The following two comments serve as a example:

> *Teachers should understand that not all students are fast learners but some are slow learners and therefore they should neither be too fast or slow in teaching mathematics. (boy, 43:2-13)*

> *The teacher should attend each and every student book not favouring some. They should talk politely and not in a harsh manner. if the teacher does this to me personally I would do better in maths. (girl, 36-4-7)*

> *Maths teachers should not favour only those who know maths e.g. selecting students who know mathematics and putting them into a group and neglecting others. They should mark all the books without discrimination and have good attitudes towards all the students.* (girl, *38:4-4*

Incidentally remarks about irascibility of teachers, homework difficulty, mathematics teaching, checking homework and individual differences were found to be more likely to come from students in the lower two quartiles. More comments on the need for right attitudes to homework for success came from students in the highest quartile in achievement.

Comments about the need to encourage students, need to take homework seriously, and on the quantity of homework came from students in all quartiles. Most of the students who complained of the need for marking homework and discussing homework also reported that their homework was rarely checked. The students' beliefs towards homework were rather surprising or they do not seem to agree with expectations. For example, 70% of students expected teachers to give them homework without consulting them. Students did not mind homework with 92% disagreeing that it is a waste of time. Good practice

would necessitate differentiated homework, but 81% of the students disagreed with such a view. They further would not want to repeat problems that they got wrong in homework. Only 31% of student expressed a view that they often know the purpose of homework, making one think that for a majority of students too, homework is a necessary ritual led by the teacher, which students acquiesce to, to go through school smoothly.

Despite these observations, it should be pointed out there were a lot of variations across and within the schools that this study smoothes out in the explanations. In schools, some correlations were very high while some were very low. Some responses to items were clustered around certain points while other classes or schools clustered around other responses. For example on why students do not complete homework 20% of Form 2 students and 41% of students in Form 4 at School S39 said it was because the homework was difficult, while only 5% of Form 4 students at S34 gave the reason of difficulty. This would show that different schools and classes had different aspirations and spirit in mathematics /homework due to their circumstances. Yet to see the bigger picture of the homework situation in Kenya, one has to take some attention away from the detail of the smaller pictures in the schools.

4.5 Teachers ' Questionnaire

Among the 147 teacher respondents, 98 were male and 49 female. Their mean teaching experience was 8.7 years with a standard deviation of 6.3 years. Most of the teachers were relatively young, with 65% of the sample having a

maximum of eight years experience. Of the sample, 71% had a teaching experience of up to 10 years, and only 15% of them had a teaching experience of over fifteen years. One may conclude that most of the teachers in the sample were graduates of the relatively new 8-4-4 education system in Kenya. About 46% of the respondents taught one or two mathematics classes, while 54% taught three or four mathematics classes. Each class would add a maximum of seven lessons a week to a teacher's load. Teachers with three or four mathematics classes were therefore, more likely to be teaching mathematics only. Those teachers with one or two mathematics classes would have had to beef up their total teaching load with their second teaching subject. An exploration of the data using contingency tables showed that the teaching experience of the mathematics teachers was not related to teachers' behaviour towards homework.

Most teachers (96%) reported that they assigned homework for all students to attempt at every lesson. This shows that there was no purposive homework, which was differentiated to cater for special interest groups. 90% (130) of the teachers reported that the kind of homework they gave was practice on the work that was covered in the lesson with only 6% reporting that they asked students to read ahead. This is unlike what Bell (1978) envisaged when he said that to be useful homework should provide the student with a combination of a review of topics covered previously with current and unfamiliar topics to help students assimilate and accommodate a variety of mathematical objects into their cognitive structures. Further, such practice homework is likely only to help

students learn facts and skills, and conceptual structures while general strategies in problem solving, investigation work and appreciation of mathematics are largely ignored.

Most teachers (90%) reported that they themselves made the decision on how much homework was assigned. Some ten teachers also mentioned the Head of Mathematics Department and the class teacher as other persons who made decisions on the amount of homework assigned.

Asked if they planned for homework they assigned, 80% of the teachers said they did. Many of those who said that they planned for homework did not answer the next question on how they did. Among the few teachers who answered this question, most of the teachers said they planned by picking questions to be assigned. Three teachers mentioned that they planned by going through the work as in the following. "*I go through the work to be assigned in order to find out where the students can easily make mistakes.*" (Lady teacher, 25:4-27) and "*selecting the questions carefully and then working them out to ascertain their difficulty level*" (male teacher, 53:3-21) and "*select questions in advance for exercise and work out questions in advance*" (male teacher, 9:1-33). Since the teacher is almost sure to be able to do all or most of the problems in the pupils' textbooks, some preparation in terms of actually working out the problems to be assigned might be some good practice. The manual for Jesuit high schools' (1957) suggests that teachers quadruple the time they spend doing problems to be assigned to estimate the time that students need to do the

homework. Incidentally, only 11% of the teachers agreed that they should do such problems

Asked if they assigned homework during the holidays, 68% (112) of the teachers answered in the affirmative. Only 22% of the Mathematics teachers did not assign homework in the holidays. However, like the regular homework during school term, teachers rarely checked it or used it any further for instruction. The main purpose of such homework seemed to help keep students busy during school holidays.

On the source of homework, 91% of the teachers reported that they got the homework from the mathematics class text, while 52% also (2^{nd} choice) reported that they also got homework from past examination papers. The most common textbooks used by most teachers were the Form course book by the Kenya Institute of Education, and Mathematics for Kenya secondary Schools by Patel. A study of the exercises found at the end of topics (and this is what was assigned) show that they are questions summarising the content of the topic testing the students mainly at the comprehension and application levels of Bloom's (1965) taxonomy. The questions seem to be modelled after the KCSE examination. There are no practical questions or further research questions in the books. It is possible that such teachers mentioning past papers as a source of homework had a Form 4 class. The teacher would probably teach a topic in class and pick some related questions from the past paper(s) and assign as homework. This may also serve to indicate how exam oriented our secondary

schools could be. 12% of the teachers wrote assignments on the chalkboard when pupils did not have the class text or when they got homework from other texts. Teachers on the whole assigned homework from textbooks yet these were reported to be few in some schools.

From Table 4.19 one notes that most mathematics teachers reported that some of their students did not complete homework they were assigned.

Table 4.19
Number of teachers whose students complete homework

Proportion	no. of teachers.	%
none	3	2.1
½	20	13.7
¾	84	57.5
All	39	26.7

Source:survey

Some 27 % of the teachers reported that all of their students completed assigned homework, while 2% of the teachers reported that none of their students completed assigned homework. In other words about three- quarters of Mathematics teachers knew that at least a quarter of their students did not complete homework. These proportions of students who completed homework were likely to be optimistic estimates as some teachers were reported not to check whether homework was done, whereas some students may cheat on completion of homework. For example, one teacher (26-4-29) gave the

proportion of students who completed his homework as three-quarters but complained in another section that less than a half hand in work to be marked when he wanted to. Still, one may be concerned with the group that did not complete homework. When we say 14% of teachers (20 teachers) reported that half of their students complete homework, then we are saying that at least eight hundred (40 x 20) students in the schools visited do not complete homework.

Incidentally, when the data was grouped by sex of students (as boys, girls and mixed) in the school taught, it was noticed that eighteen mathematics teachers (36%) from boys' schools reported that all of their students finished homework (mixed schools had 10 teachers (21%). Looked at another way, only 4 teachers (8%) in boys schools reported that up to a half of their students did not complete homework, compared with six teachers (13%) in girls schools and 13 (27%) in mixed schools.

Thus the order of percentage students who completed mathematics homework assigned seems to be boys' school, girls' schools and mixed schools in that order. Since many of the mixed schools had students who are relatively weaker academically, we may guess that the completion of homework was related to the perceived difficulty of the homework.

On holiday homework, five teachers (10%) in boys' schools assigned none as compared to 17 teachers (35%) in mixed schools. In other words, mathematics teachers in boys' schools were more likely to assign homework during the

holidays, followed by teachers in girls' schools and finally by teachers in mixed schools. This may be because mathematics teachers in mixed schools less expected their students to do such homework.

To clarify this, teachers were asked to judge generally how good their students were in mathematics on a scale of 1 to 4 in ascending order, (explained to be associated with grades E/D, C, B, and A. Generally, 67% of the mathematics teachers believed their students to be poor. Responses from teachers in boys' schools were concentrated around grade C and B (37% and 47% = 84%), girls schools around E/D, C and B (19.6% ,54.6% and 15.2% = 89%), and mixed schools around E/D and C (23.7%, 61.7%= 85%). That is, teachers in boys' schools perceived their students to be better students than mathematics teachers in the mixed schools. Such perception may be a reflection of the teachers' expectation that boys can do better than girls in mathematics

What did mathematics teachers do when their students did not complete homework? The main categories for the responses were 'punish' (40%), 'insist that they first complete it' (56%) and 16% would 'reprimand the students'. The percentages would add to over 100% because some 42 teachers chose a second response. When teachers were divided by location of their school it seemed that punishment for non-completion of homework is more common in rural schools than in urban schools. Only seven teachers mentioned sending students out of class for non-completion of homework. In two schools the researcher also witnessed cases of boarding students being sent home (by the mathematics

teacher through the school administration office) to bring a parent for non-completion of homework, but that was not reported by any teacher. With the kind of numbers reported earlier as not completing homework, mathematics teachers might spend quite some time dealing with homework issues.

On marking, 52 teachers (36%) reported that they rarely (occasionally or never) marked students' work with teachers in girls schools reporting a higher percentage than average (twenty teachers or 44%). This agrees with earlier data reviewed which revealed that girls' homework is marked less often than that of boys. 40% of the teachers reported that they mark all homework. We should put a caveat in interpreting this percentage because a number of comments from students implied that teachers may mark only books of selected few students.

The methods that teachers preferred to mark with (find practical) were mainly: commenting on difficult problems asked by students (42%), marking each pupils work (38%) and providing answers for students to mark (18%). This may mean that even among the 40 % of teachers who said that they marked all homework, there were some who rarely saw the work of their students. Incidentally, these are the same methods that most students preferred to be used for them to know how they were getting on. It is interesting to note that the order of practicality of marking methods given by teachers is similar to the students' preference order for marking methods. Or perhaps students just wrote what happens in their classes.

Any marked assignment was returned by the next lesson by 79% of the teachers. Twenty-four teachers (17%) returned it by the end of the week. If homework collected for marking was not returned soon, students would be constrained in doing more mathematics work in the meanwhile, unless students had at least two mathematics exercise books. Only in five schools were students found to have two exercise books for mathematics, and this seemed to depend on particular class teachers (not the school).

About 89% of the teachers gave answers to an assignment at the beginning of the next lesson. Any issues on homework were discussed at the beginning of the following lesson by 76% of the teachers. Another 12% (15 teachers) discussed homework issues at a subsequent prep, while Eleven teachers (8%) discussed homework with those interested individuals (the latter meaning homework was assigned but not discussed in class). Homework was normally given at the end of the lesson around the time that the end of lesson bell rang. Since most teachers discussed homework in the next lesson, this may mean that students often proceeded to do homework without adequate clarity of what was expected of them, except to do specific problems from the class text. As it can be seen homework can take a lot of time.

Most of the teacher respondents (73%) mentioned that the biggest hindrance to marking homework was a big teaching load (number of lessons taught in a week). Fifteen teachers (13%) mentioned poor students as the reason they found it discouraging to mark (one teacher put it that he could mark his students'

mathematics homework with his eyes closed- to indicate how poor they are), while 11% attributed their hindrance to big classes that discourage one to mark.

Who made decisions about homework in the school? A majority of the teacher respondents (90%) reported that they decided themselves on how much homework to assign and to check. Perhaps this is an area where head teachers could help. In schools that achieved better in mathematics it was noted that there was accountability of the teacher and students in their use of time. The word 'time' was more likely to be used in explanations given in the questionnaire or in discussion. The school principal kept tuned to the academic school directly or through the Heads of Department.

It was noted that only in about a quarter of the schools (10% of the teachers) was the homework checked by someone else other than by the teacher. Since in most of these cases only one teacher in a school said the Head of Department checks, one may guess that such respondents were the Heads of Department. Ideally, the Head of Mathematics Department (HOD) should monitor the teaching in his department but practically the head of department was judged to have little authority over the class mathematics teacher, unless such HOD was well supported by the school Principal. The feeling one got on the ground was that mathematics teachers were more or less autonomous in assigning and marking homework with HOD's of mathematics exercising little formal control.

Teachers were also asked to whom they gave remedial help in the school Mathematics work. This statement was expected to provide a clue as to the academic focus (concern for academic excellence) of the teacher and the school. About a third of the teachers did not respond to this item. Of those who did, 35% (35 teachers) reported that they gave extra help those failing students identified as weak, 20% gave it to all students while 40% of the teachers reported that they gave help to those who sought it. Most likely these might be some enthusiastic students who would seek such help. Like Bell & Costello (1983) point out, not all students who like Mathematics excel in it, nor do those students who are good in mathematics always enjoy it. Helping those who sought for help would leave out many students who deserved to be helped to catch up in Mathematics but who were not courageous enough to present themselves to the teacher. It may also be pointed out that a closer look at the data showed that most of the teachers who mentioned helping weak students came from the better performing schools in KCSE mathematics. In most of the poor performing schools teachers were more likely not to respond or to say that they helped those who came to them for help. Few students may be helped this way as elsewhere in the study it is reported that some students perceived their mathematics teachers as unapproachable. A Pearson correlation of the order of 0.6, with a significance value of 0.000 was found between the proportion of mathematics teacher respondents in a school who helped weak pupils, and the school's KCSE mathematics mean score. This however may need a more controlled study to determine certainly the relationships between remedial teaching and student performance.

On a follow-up question about the kinds of remedial help teachers give to their students of mathematics, only 85 (just over half) mathematics teachers responded. Among the common kinds of remedial help mathematics teachers gave were helping weak students (25%), done by giving them extra work that matched their level; assisting individuals who sought assistance (22%); helping students solve difficult problems after homework (11%), and giving extra lessons during preps (11%). Only three teachers reported giving re-teaching of the topic when students had a problem with mathematics homework. Five teachers mentioned private coaching as a form of remedial help given to students. In one school, the Mathematics teacher was getting paid some extra money by some few parents to revise Mathematics class work (coach) with those parents' children during preps and on Saturday mornings. Students of that particular teacher got significantly higher grades than students of other teachers in the school, presumably because he spent more time with such students.

Teachers were asked about the worst thing about homework in an open question. The answers given were analysed and put into themes. Fifty four of the teacher respondents (43%) perceived 'students copying each others work' as the worst thing about homework, 22% that it is 'too much work for the teacher', and 17% complained of 'non completion' of work they assigned. Other comments were that it was boring (16 teachers), routine that overloaded students (5 teachers), and that homework was often done contrary to what students were shown in class (5 teachers). This may mean that the teachers were

not on the whole very happy with the situation that obtained from homework, the dissatisfaction being loaded on the students (copying, non- completion, doing it wrongly).

Students, however, complained that teachers said they copied even when they had not. Either teachers over reported the problem of copying or students under reported it, since over half of the teachers thought it was a problem. Another possible explanation is that due to difficulty, students worked out homework in groups or in consultation with other students. When such students presented their work for marking the teacher was likely to see some similarity in the presentation of the work. Students were also more likely to copy when they knew that their teacher would not check the homework, or at least not thoroughly.

The responses of teachers when asked to respond to an open question on 'the best thing about homework is...' were analysed using the themes used earlier to analyse those of students on the most important thing about homework. The response that homework gives students practice was written by 51% of the teacher respondents. They said that homework gives students a chance to practice on content taught and at the same time to increase their knowledge. This is consistent with the idea that homework is useful to students (regardless of what teachers do about homework) and students should get lots of it. Another 18% of the teachers stated that the best thing about mathematics homework is that it helps students test their understanding of the content taught. Interestingly,

each of these two themes received below 5% of the responses from the students. The reader may remember that the most frequent responses to this question from students were 'learning to work alone' (52%) and 'getting feedback from working out problems' (34%).

Of the teachers, 17 % said that they were able to evaluate the success and progress of their teaching through mathematics homework. This is an important answer considering the fact that homework should be given to serve some specified objective(s). If the objective was to test understanding of the topic, then performance of students in homework would be able to test if the topic was successfully learnt. Unfortunately, homework seemed to be perceived by teachers as a student business, something students had to do.

Of the extra comments that teachers volunteered, 32% were on the importance of homework, while 18% of the teachers complained that students attitude to homework was negative. Some few teachers (8%) mentioned that the teaching load for mathematics teachers be reduced to about 15 to 18 lessons, and the class size reduced to about 20 to 25 students, to allow for more efficient teaching of mathematics including marking homework. This study notes the 8% of the teachers who commented that teachers needed to design homework better to motivate students to do it.

4.6 Results and discussion on the hypotheses

Below are reported the results obtained in testing the hypothesis of the study.

H_o1: Time spent on daily homework and achievement

The first null hypothesis stated that "There is no significant relationship between time spent on homework and achievement in mathematics". To test this hypothesis the Spearman's rho correlation is reported in Table 4.20. The correlation was checked between both test scores in class tests and the KCSE mathematics grades with the average time spent on homewwork (hwtime) and the relative time students spent on own mathematics practice (RETIMP).

Table 4.20
Spearman's correlation between homework time and selected variables

		Hwtime	KCSE	TEST score	RETIMP
Hwtime	rho	1.000	-0.186**	-0.172**	-0.184**
	Sigf.	-	0.000	0.000	0.000
	N	1748	828	1613	1713
KCSE	rho	0.186**	1.000	0 .859**	0.072
	Sigf.	0.000	-	0.000	0.040
	N	828	841	831	823
RETIMP	rho	-0.184**	0.072*	0.059*	1.000
	Sigf.	0.000	0.040	0.018.	-
	N	1713	823	1607	1741
TEST score	rho	-0.172**	0.859**	1.000	0.059*
	sigf.	0.000	0.000	-	0.018
	N	1613	831	1642	1607

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

From Table 4.20, one sees that there is a low but significant negative relationship between the average time individual students spend on daily

mathematics homework (hwtime) and achievement. In other words, there is a tendency for lower performing students to spend more time on homework. This may not be surprising since this study found that, generally, teachers assign the same homework for all students to do. Some students are likely to finish quickly while others are likely to waste a lot of time trying to fathom the homework.

Unfortunately these weaker students may have been convinced that they could not learn mathematics when they know that they spend more time to finish a task that other students complete in significantly less time. Such students could become discouraged and yet they are the students who need encouragement most.

Homework assigned in different schools may differ in quantity and in the relative difficulty (with respect to particular students). When correlations between time spent and achievement for individual schools were calculated, the relationship seemed to hold except that for some schools it was high and significant whereas in some few schools it was low but still positive. The average time individual students spend on homework assigned in a day is likely to depend on the student and on the task itself. In the few schools where there was a low positive relationship between homework time and achievement, the teacher was likely to be using a more individualised approach in assigning mathematics homework and helping students who were in difficulty.

Alternatively, students were asked to say how much time they spent on own

related to relative time spent on own practice. This would mean that there is a tendency for students who spend more time on homework (read low achievers) to spend less time on own practice. A few good students (from their test score or KCSE mathematics scores) complained that too much homework denied them the opportunity to do their own practice, yet this is what would count in a the KCSE. This may not be true if the mathematics teacher set homework on a variety of mathematical skills. The majority of the teachers gave homework to give students practice in the topic taught in the day, so it could not be very useful for revising mathematics.

From the Table 4.20, it is also clear that mathematics test scores for Form 4 students and the KCSE grades for the same students are highly correlated (0.859) and significant at the 0.001 level. This might help to allay fears about the reliability of the class teachers test scores used in the study.

H_O2: Gender/ hwtime

H02 There is no significant difference between boys and girls on the amount of time they spend on mathematics homework

To test this hypothesis the t test, a parametric test was used. The t test is based On the fact that the standard error of the difference of the means in two groups Is normally distributed (just like the standard error of the mean).

$$t = \frac{\text{sample 1 mean} - \text{sample 2 mean}}{\text{Standard error of the difference in the two means}}$$

The results are shown in Table 4.21.

Table 4.21
t test for equality of means for boys and girls on time spent on homework

Group statistics						
gender	n		M	SD		SEM
Boys	861		1.28	0.437		0.0149
Girls	887		1.26	0.452		0.0152
t test for equality of means						
F	sig. of F	t	df	sig.	Mean dif	SE dif.
1.956	0.162	0.840	1746	0.401	0.01787	0.05962

F is not significant since the probability (0.162) > 0.05, hence the variances for the two groups are similar. The t value is not significant since the p value (0.401) is greater than 0.05. This indicates that there is no difference between boys and girls on the amount of time they spend on daily homework.

H_O3: Homework time / Residential status

H03: There is no significant difference between boarders and day scholars in time spent on daily homework.

The t- test was used to test this hypothesis. The standard deviation and standard error of the mean are included.

Table 4.22
t test for equality of means for boarding/day on time spent on homework

Group statistics						
residence	n		M	SD		SEM
boarding	812		1.34	0.46		0.0162
day	923		1.21	0.42		0.0139
t test for equality of means						
F	sig. of F	t	df	sig.	Mean dif	SE dif.
12.507	0.000	5.921	1733	0.000	0.1253	0.02116

For the t test, the F value and its significance(sig), degrees of freedom (df), mean difference (M dif) and standard error of the difference (SE dif.) are also shown in Table 4.22. The variances for the groups are different (from the significance of F value), and t is significant. This means that there was a statistically significant difference between boarders and day scholars in the time they spent on daily homework. From the means one sees that day scholars took slightly longer than the boarders, and the spread of the time (the variation in time day scholars spend on homework) is higher than for boarders.

H_O4: Homework time / class

HO4 There is no significant difference between Form 4 students and Form 2 students in the amount of time they spend on mathematics homework

Table 4.23
t test for Form 2 and Form 4 students on time spent on homework

Group statistics				
class	n	M	SD	SEM
Form 2	878	1.22	0.448	0.0151
Form 4	870	1.33	0.436	0.0147

t test for equality of means						
F	sig. of F	t	df	sig.	M dif.	SE dif.
0.284	0.594	-4.853	1746	0.000	-0.1026	0.02115

Since the F value is not significant the variances for the two groups are not different (i.e. are similar). But looking at the significance of the t value, we find that t is significant (since p = 0.000), therefore the means of the two groups are different. There is a significant difference between Form 4 and Form 2 students in the time they spent on mathematics homework. The group means above

indicate that Form 4 students took more time with homework. Incidentally, the Mann-Whitney test would have yielded comparable results.

Hypotheses $H_0$5, H_O6, and H_O7 dwelt on the difference between

(i) boys and girls .

(ii) boarders and day scholars and

(iii) Form 2 and Form 4 students respectively with respect to perceived homework difficulty.

Students had been asked to say how difficult the homework they usually got was on a scale of 1 to 4 (very difficult to easy). These hypotheses are tested using a non-parametric test, the Mann–Whitney U test, since the variable homework difficulty was ordinal. The Mann-Whitney U test is almost as powerful as the t- test, and tests the number of times an item is ranked higher in one group over another group. The Z statistic corrects for ties in the two groups. The results for the three hypothesis from the Mann- Whitney U test are shown below:

H_O5: Perceived homework difficulty by gender

HO5 There is no significant difference between boys and girls in their perception of homework.

The significance for the z value is greater than 0.05, thus it is not significant even at the 0.05 level (Table 4.24). The hypothesis was accepted. There is no difference between boys and girls in their perception of homework difficulty in mathematics.

Table 4.24
Test of difference between boys and girls on difficulty of homework

gender	n	mean rank
boys	872	905.28
girls	896	864.27

Mann-Whitney U	372533.5
Wilcoxon W	774389.5
Z	-1.802
Asymp. Sig. (2 tailed)	0.072

H_O6: Homework difficulty by class

HO6 There is no significant difference between Form 2 and Form 4 students in their perception of difficulty of mathematics homework

The results of the test are shown in Table 4.25 below.

Table 4.25
Test of difference between Form 2 and Form 4 on difficulty of homework

gender	n	mean rank
Form 2	889	946.86
Form 4	879	821.43

Mann-Whitney U	335277
Wilcoxon W	722037
Z	-5.513
Asymp. Sig. (2 tailed)	0.000

In this case, the Z static's significance is 0.000 and thus it is significant. The hypothesis is accordingly rejected. There was a significant difference between Form 2 and Form 4 students in their perception of homework difficulty, with more Form 4 students than Form 2 students seeing it as difficult.

H_O7: Attitude to homework/ gender

HO7 There is no significant difference between boys and girls in their attitudes to mathematics homework.

Table 4.26
Differences between boys and girls on attitude to homework

Group statistics						
gender	n	M	SD	SEM		
Boys	654	50.34	6.24	0.244		
Girls	686	49.34	6.30	0.241		
t test for equality of means						
F	sig. of F	t	df	sig.	Mean dif	SE dif.
1.077	0.300	2.916	1338	0.004	1.000	0.343

The variances of the two groups (boys and girls) are not different, but the probability value for t is less than 0.05, thus it is significant at the 0.05 level. Boys and girls differred in their attitudes to mathematics homework, with boys slightly ahead.

H_O8: Atttitude to homework / class

HO8 There is no difference between Form 2 and Form 4 students in their attitude to mathematics homework.

From the F value, the variance of the two groups is similar. The t value is not significant thus there is no significant difference between Form 4 and Form 2 students in their attitudes to homework. Results of the t test for independence of the two groups is shown in Table 4.27.

Table 4.27
Difference between Form 2 and Form 4 on attitude to homework

Group statistics					
class	n	M	SD	SEM	
Form 2	664	49.94	6.26	0.243	
Form 4	676	49.72	6.33	0.243	
t test for equality of means .					
F	sig. of F	t	df	sig	Mean dif	SE dif.
0.653	0.419	0.647	1338	0.518	0.222	0.343

H_O9: Attitude to homework/ residential status)

HO9 There is no difference between secondary boarding and day school students in their attitude to mathematics homework. The t-test was used as shown in the table below.

Table 4.28
t test for difference between boarders and day scholars on attitude to homework

Group statistics					
residence	n	M	SD	SEM	
day	592	48.75	6.06	0.249	
boarding	739	50.75	6.32	0.232	
t test for equality of means					
F	sig. of F	t	df	sig.	Mean dif	SE dif.
0.452	0.502	-5.851	1329	0.000	-2.003	-0.342

From the table one sees that the variances for the two groups are similar (since p for F >0.05). But the t value is significant, thus boarders and day scholars differred in their attitudes to homework, with boarders on the lead.

H_O10: Self-rating /attitude to homework

HO10 There is no significant correlation between students' self rating in mathematics and their attitudes to homework.

The Spearman Rank Order (non-parametric) was used to correlate the two variables, with the results: r =0.267, sig. (two tailed) 0.000, n =1403.

Evidently, students' self-rating of their ability in Mathematics is related, even though low, to their attitudes. It is not possible, however, to say from the data available if positive attitudes to Mathematics are a result of high self-rating or vice-versa.

4.7 Un-hypothesised findings

HO11 student characteristics and the provinces

Table 4.29 about here shows the summarised relationships using the Kruskal Wallis test.

Table 4.29

Kruskal Wallis test on some unhypothesised differences over the provinces.

province	Homewok difficulty		Self-rating in maths		Time on own practice	
	n	mean rank	n	mean rank	n	mean rank
1	251	901.45	348	940.83	345	813.19
2	630	854.20	636	876.03	623	863.14
3	400	907.71	401	897.56	395	933.66
4	387	894.43	386	840.98	378	871.24
Kruskal Wallace Test statistics						
χ^2	4.079		9.288		12.245	
df	3		3		3	
asymptt. sig	0.253		0.026		0.007	

It would appear that students in the provinces differed by age and in achievement in mathematics. Students in different provinces may differ in age because of the province's culture that tends to take children to school early or late, or it might be related to the problem of repetition in the primary classes. The Kruskal Walis test used is similar to the Mann-Whitney U test explained earlier except that it can handle more than two variables.

At the 0.05 level, students self-rating, and the relative amount students take in own mathematics practice appear to have been different over the provinces visited. The perceived difficulty of homework, is, however similar.

HO12 Relationship between marking frequency and achievement

HO12 There is no significant relationship between marking frequency and achievement.

To test this hypothesis the students rating on a scale of 1(never) to 4 (all homework) of how often homework their was marked was correlated using Spearman's rho with student achievement scores. The latter test was used due to reservations on the reported marked homework frequency discussed earlier. This test showed some low correlation between how often homework was marked, and achievement as measured by the following variables:

Testscores	rho = 0.107	sig 0.000, N=1605
KCSE	rho = 0.101	sig 0.004, N=827
Self rating	rho = 0.172	sig.0.000, N=1742

As can be seen, it seems students' achievement in mathematics is related to the frequency of marking mathematics homework. Students' self-rating seems

related with the frequency of marking homework. Students who thought they were good in mathematics seem to have had their work marked more often.

HO13: Attitude to homework and achievement

There is no significant relationship between students' attitude to mathematics homework and their achievement in mathematics.

To test the hypothesis the Spearman's rank order coefficient was calculated with the following results: attitude score with;

Test scores r = 0.287, sig. 0.000, N=1231

KCSE r= 0.300, sig. 0.000, N=641

There was a significant low relationship between students' attitude to homework and achievement. The relationship was significant at the 0.05 level (and also at the 0.01 level).

4.9 Interviews and observation

The interviews were a secondary instrument aimed at getting a better picture of the schools and to clarify issues that might come up from the questionnaires. The principals and/or deputy principals in all 51 and 43 heads of mathematics department in schools were interviewed. The unstructured interview dwelt on homework and how it does, or may contribute to achievement of mathematics in the school. The discussion also included a comment by the heads of schools on the perceived reasons for poor performance in mathematics in their schools.

Observation was done in seventeen out of the twenty classrooms selected with a

view to obtaining data that would help understand pupils comments. Nine Form 2 classes and eight Form 4 classes were observed. The mean class sizes for Form 2 and 4 were 41.5 and 34.3 respectively. In Form 2 the range was 18 students (32 –40) while the range in Form 4 was 29 (15 – 44). When teachers mentioned large classes they may have meant classes with fifty or more students.

It was observed that in many cases (88%), the teachers used expository strategies to teach mathematics. In a majority of the cases (81%), the teacher would explain examples from the textbook as pupils listened and finally give some assignment on the material covered. Two teachers (12%) mentioned how the homework was to be done and when it was due. In other cases, it is thought, perhaps both the teacher and students knew implicitly when the homework was due. Homework was always given in the last two minutes of the lesson, or in two cases after the lesson bell had gone. The average time that homework took in the lesson ranged from 0 to 32 minutes. In the zero time case, no homework was discussed or assigned, while in the 32 minute case, there was checking if the home was done before the teacher discussed it on the chalkboard. The mean time spent on homework was 13 minutes in a lesson (32.5%).It was noted that only for three (18%) classes was the students checked regularly by the teacher. In other cases the teacher would read out the answers (more likely in a poor school) or discuss the homework on the chalkboard as students marked, or just checked if it was done and went on with the lesson.

From the interviews with the school administrators, it was apparent that many principals of the secondary schools are more concerned with the relative performance of mathematics than with the raising absolute standards. In a majority of schools (92%), there was a form of analysis of the KCSE examination and teachers were expected to explain the students performance in their subjects. This exerted some pressure o the teachers to work harder, but it may be discouraging to mathematics teachers whose subject was likely to be ranked lowest year in year out . The pressure was hard on the teacher especially around the time the KCSE results were announced, but eased away with time. In the better performing schools, teachers in casual conversations mentioned the pressure to deliver results as a limitation to good teaching in mathematics including homework.

Other than asking mathematics teachers to explain poor performance, most heads were apparently not sure of what to do to raise the achievement in mathematics or did not particularly care about such performance. Mathematics was most likely the subject that was most poorly performed in most schools. In the better performing schools, however, the performance of mathematics was comparable to the other subjects.

The following are the reasons principals advanced for the poor performance in Mathematics in secondary schools: students' attitudes (49%), weak students (20%), poor teaching (16%) or the community attitude towards mathematics (6%), administration (6%) and subject difficulty (4%). According to heads of

department, attitudes towards mathematics (45.5%) and poor students (22.7%) were among the problems that led to poor performance in their schools. The teaching methods were also lamented on.

Principals who mentioned administration as a reason for poor performance in the school were talking of their predecessors, not of themselves. However, the administration in the whole seemed helpless in implementing practical structures to help ameliorate the situation. More prep hours was mentioned as one way in which students were made to work harder. Working with parents to convince them to supervise their children more closely was another method floated on how schools are dealing with the problem of low performance in mathematics.

Four Heads of Mathematics department in day schools mentioned that their schools asked parents to encourage their students to do homework. The more common answer, though, was that the school conducted many (three to six in a term) Continuous Assessment Tests (CATs). Too many tests could take so much of the teacher's time marking at the expense of helping deserving cases. Although teachers marked such tests some marks from such tests in some schools were found not to be entered in the school's central mark book as long as an year later. This means that the tests could also have been a formality with little instructional value beyond labelling students as weak or strong in mathematics. The disposition, that concern towards students who are identified by the CATs as weak or strong, is more important than the CATs

themselves. Such feelings were echoed at S9.

It was noted that there is a trend in secondary schools of computerising student performance records. It is hoped that such an innovation trend can help provide timely information about students that need corrective action. Properly designed student management information systems may enable the school administration know what classes need attention, and the teacher to know what topics need to be re-taught, and where more homework needs to be assigned.

Only four principals reported to be checking if homework was marked themselves. They would occasionally collect a few students books at random to see whether such homework was checked. Some also asked for weekly reports from class teachers about their classes. The majority of head teachers reported that they trusted their teachers to do their work well. Trusting teachers would work well in schools where a tradition of hard work is already well ingrained in the school, otherwise teachers might just teach ,as in appearing in a class and assigning homework. A student in one school remarked that there is no point of giving homework yet the teacher does not teach. In the bigger schools the Dean of Studies, Heads of Departments (HODs) and class teachers could supplement the head teachers efforts to ensure efficiency in mathematics homework.

It was observed that in the majority of schools there was drop in the mathematics KCSE mean score in 1999 compared with 1998 and other former years. When asked to comment on such drop the majority HODs of

mathematics, blamed the poor performance on students – that they were particularly poor, or that their attitudes were negative, that they had learnt wrong working methods from primary school or even that not any student could learn mathematics. In some schools, the researcher was contented to note that the HOD found the question difficult to answer and commented to the effect that they were also baffled by the performance of their students. This meant that the students did not perform to their expectations. Some few HODs were, however, able to pinpoint the problem: that though the examination was manageable, the format of the exam 1999 was unusual with content usually in Paper 1 being tested in Paper 2. So apparently, students had not being drilled for such an eventuality! This might indicate that much of the mathematics teaching was directed towards the examinations, and not so much for understanding .

One also got the feeling that too much pressure was exerted on the students' side to succeed. Most teachers wanted their students to excel in mathematics but few were willing to put the effort to guide their students, or knew what to do to achieve such success. (Such HOD's and teachers constantly requested the researcher was to tell them the secret of success in mathematics). Students would thus be coerced by punishment, repetition of classes, or even expulsion from the school. Such coercive techniques were not mentioned in the discussions with principals but came up in casual conversations with mathematics teachers in the course of discussions and interviews.

Properly designed homework may help in the gradual build up of skills, and in

the monitoring of students towards excellence. In the better performing schools the HODs seemed to be conscious of the expectation that their students should perform well in mathematics, and designed strategies to move towards such a goal. One HOD of mathematics at school S54 whose students got several 'A' grades in his class in a "poor' school giving this personal testimony ;

> *Though I have been a mathematics teacher for the last fifteen years, I have only learnt to teach in the last five years or so. ... I now look back to see if students understood rather than whether I was tired teaching. I mark pupils' homework frequently to see the problems they are encountering and help them out. I never let a student's performance* in *class influence my view of their ability...54:3-31*

One got a feeling that the school principal could do a lot more to raise the achievement in mathematics. One way would be through ensuring that there is more accountability of the teachers and students in their use of time. In two of the leading schools in mathematics performance at KCSE, the researcher had to convince the principal that the questionnaires and classroom observation would not significantly interfere with the students use of time. Some teachers also echoed this concern that it was the principal who set the pace, the expectations in a school. Principals who are rarely in school cannot have the moral courage to insist that teachers be in the school or be accountable on their time in the school.

In one school, the researcher found some mathematics teachers playing darts. The researcher announced that he wanted to get some help. The Head of Department of mathematics said (in Kiswahili) as he continued to play his turn, "haina haja na mtu hii hesabu hapa", (In this school nobody cares about mathematics). "We only teach it because it is our area of specialisation. If it

were made optional we would have two or three students."

Head teachers can help improve mathematics performance and general performance by forming a work culture which encourages teachers to give a little time to their work. Perhaps such zeal is what helps heads with a missionary spirit convert weak schools into great ones (e.g. Starehe Boys and Precious Blood Girls). Noisy staff rooms may be a disincentive, actually hindering teachers from giving that little more time their work, especially in marking mathematics homework. But this may be the subject of another study.

One Head of Mathematics Department at school S20 when asked why he thinks their school performed relatively well at KCSE mathematics said:

> I was at ---- school [S21] and we would work very hard but students were not performing. Our results were never as good as in this place. I think it has to do with the school tradition . we found a tradition . You find yourself more comfortable by fitting into the work pattern.

The HOD, mathematics at school S9 repeated the same thing; " I think this school is a very different system [from his previous teaching school]. I work much more. But more so, I believe it's the spirit of the school, the disposition of students and teachers towards success." The Principal at S45 again echoed this saying "we have set a tradition in this school. Whoever comes in must toe the line. The thing is, when you come here you must fit in, otherwise you go. Different classes in a stream are taken by different teachers as a quality control check." Such comment on the importance of 'fitting in' is also made by Griffin (1986) about Starehe school, and by the principal at school S48.

One may think that the principals who are high in 'initiating structure' are more likely to get better academic results than those high in 'consideration'. Though this study is not well placed to make such a conclusion, it was apparent that the relative authority of the principal in relation to the teachers was likely to get more out of the mathematics teachers. In a number of staff rooms of schools visited, it was observed that there was a television set or a darts board which involved teachers to an extent of getting late for a class after a bell. Whereas it might be good to provide such amenities, they are likely to be counter productive to the academic good of the school. The researcher, however, also formed the opinion that some in some schools, things were too much centred on the principal. Such tight control may limit the creativity of the school system and impinge negatively in the overall academic achievement of the school, including mathematics.

The school principal with the support of the community can lead the way in teachers, and students developing, maintaining, a culture of, and expectation of, hard work and excellence. At school S9, the researcher was told of a culture of concern by the school for any student not performing to expectations. Such concern for individual students, and respect for honest work ethic can only be nurtured with the support and example (leadership) of the principal.

Two principals narrated how they changed their schools from low performing in mathematics to high achievement. Both said it was through encouraging a few selected mathematics teachers to encourage students through positive talk about

the importance of mathematics and through simpler assignments in which students got most or all of the problems right. Two heads of departments of mathematics in some two good performing schools added that in their schools they were doing more work (especially marking) than they used to in their previous schools. In the better performing schools it was reported that more was demanded of the teachers.

From the KCSE and test scores observed in schools, mathematics achievement was also observed to differ between classes in a school, showing how important the effort of the individual teacher is in mathematics. A Head of Department could set the pace as a model teacher, to show how daily homework can be used to lay a foundation for better future performance in mathematics, but teachers were still free to emulate such model or ignore it. Heads of Department of Mathematics were noted to be performing an important role in maintaining the standards in the examinations set and scored, maintaining a departmental mark book, but their effectiveness in promoting more efficient teaching largely depended on the support of their school (principal).

In many of the schools the situation in boarding schools is such that the students are left to do prep on their own or with one teacher on duty who sits in the staff-room. It seems Eshiwani's (1983:27) comment about prep not being taken seriously was still valid . Prefects in a good school may control the students in not making noise in the classrooms to create environments for conducive study, but if a student was stuck in mathematics homework, there is no teacher

to consult. In two poorly performing boarding schools which didn't have any teacher's house, such problem was reported by the HODs mathematics that their students were left unsupervised and that nobody knew whether students did prep or not. In most schools teachers live outside the school, and are thus in a hurry to catch the next matatu or walk home after 4.00 p.m. In such circumstances teachers would not (and do not) carry a bag of exercise books home. Mathematics teaching is thus likely to suffer, depending so much as it does on marking and checking of students work.

Teachers who did not commute to their homes were reported to be more likely to be found in the staff-room over evenings and after classes working. Provision of teacher housing is likely to encourage mathematics teachers to put more time with their students. Six head teachers, though, mentioned that it was usual to find teachers in their school putting some extra time into their work, say, marking and planning for some future lesson.

Some teachers, with the support of their schools had joined local mathematical associations, which organised mathematics contests for students. This was likely to encourage students to put more time in mathematics. Unfortunately, this was only likely to benefit the better students who were already good in mathematics. Ways must be found to reach the majority of the students who are average or poor in mathematics.

CHAPTER 5:

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Introduction

In this final chapter of this study of mathematics homework practices in Kenyan secondary schools, we summarise the study, recapitulate its findings, and present our conclusions and recommendations arising there of. The results from the hypotheses are summarised first, and then other findings that helped to answer the research questions are reported.

5.1 Summary

Homework is a common phenomenon in many Kenyan secondary schools, defined as work that is assigned by the class teacher to be done outside the class time. The poor performance of secondary school students in mathematics is a concern to many. (c.f. Daily Nation 1998, February 25:6 and Standard 1992,June 9:8). This is despite the fact that mathematics teaching in Kenya secondary schools is given almost five hours or 11.1 % of instructional time in a week.

Homework is part of teacher's strategies (Stern, 1995) which has an impact on learning outcomes in mathematics. Yet there has not been so much research on what is done, how it is done and how homework can be planned to meet the needs of different pupils. This thesis was an attempt at a more detailed study to highlight the situation in Kenya.

This study had the following objectives: Identify the nature of mathematics homework given to secondary school students in Kenya; Investigate teachers'

perceptions on the value of homework; Find out the opinions of secondary school students regarding homework;Investigate the relationship between selected demographic, psychological and school variables in relation to homework and achievement in mathematics.

This research was designed as a cross sectional survey. It collated original information on homework in an effort to observe, identify and describe behaviours and teaching related to homework after Strang, (1975). A multistage random sample of 1783 secondary school students and 147 mathematics teachers was selected in four administrative provinces of Kenya namely; Central, Coast, Nairobi and Western. The students were selected from Form 2 and Form 4 classes in the secondary schools. Mathematics teachers of Form 2 and Form 4 classes were selected from the schools selected. Questionnaires and achievement tests were the main instruments used to collect the data for the study. Interviews and classroom observation were also used to provide supplementary information, which was used to explain and validate the data obtained from the main instruments.

Descriptive statistics and inferential statistics were used to summarize and discuss the findings presented in the study.

5.1 Summary of the hypothesised findings

It was found that there is a negative correlation between time spent on mathematics homework and achievement in mathematics. The relationship was negative with the better students taking less time on mathematics homework

than the weaker ones. This perhaps occurred because the homework given was uniform for all students in a class. This, however, is inexpedient because poor students need to be encouraged through homework.

Time spent on mathematics homework was found not to differ by gender of the student but differed significantly between boarders and day scholars, and between Form 4 students and Form 2 students. The day scholars and the Form 4 students in each case estimated to take relatively more time on homework, this being related perhaps to the difficulty visa avis the help they got in overcoming such difficulty.

There was no significant difference between perceived mathematics homework difficulty between boys and girls. It was found, however, that there was a significant difference between Form 4 and Form 2 students in their perception of mathematics homework difficulty, with the Form 4 students perceiving it as more difficult.

Boys and girls were found to differ on their attitudes to mathematics homework, with boys slightly ahead. Boarders and day scholars, too, seemed to differ on their attitudes to homework with boarders having a slightly higher mean score. This might be related to the students' achievement in mathematics. The students self-rating of their own ability in mathematics was found to be significantly related to their attitude to homework. The self-rating seemed to be a malleable variable that may be related to the students' environment.

The frequency of marking mathematics homework showed a very low but significant relationship with students achievement but due to the uncertainties (earlier discussed) in the data to this item, it is difficult to be certain of the relationship.

5.2 summary of other findings

Mathematics homework was assigned and done in all the schools visited. It was also found that the term homework and assignment were being used interchangeably. One teacher explained that homework sounds like work to be done at home, so the term assignment is more appropriate in boarding schools where the students do not do the assigned work at home.

Mathematics homework was given almost daily (in every lesson by 96% of teachers), and is the same for all students in a class (100% of the teachers!) in the respective schools involved in the study. The mathematics homework assigned was practice exercises almost invariably sourced from students' textbooks and, to a lesser extent past examination papers. Such homework was given at the end of the lesson, and revised or revisited at the beginning of a subsequent next lesson.

Students did not mind being assigned the same homework, in fact they thought that is the way things should be. The amount of the homework assigned, and whether it is marked or not, seemed to depend more on the initiative of an individual mathematics teacher than on the school. Overall, students were

agreed on the importance of homework in mathematics, but they were dissatisfied with the quantity of work given.

About 70% of the students gave difficulty and the amount of mathematics homework as reasons for non-completion of homework. So many extra comments were written at the end of the students' questionnaire about too much homework and students receiving homework on a topic they hadn't understood in class. In fact, a thread that seemed to run through out the study was a relationship between performance of mathematics homework and understanding (for example mathematics difficulty, teaching for understanding).

Ten percent of the students admitted to copying (cheating) in mathematics homework, especially when there was a threat of punishment, or the homework was a lot. Students were fairly frank, for it was found that the percentages of students who mentioned copying as a strategy to beat completion of homework for those who gave their identities and for those who didn't were comparable. The actual percentage is likely to be higher. Many teachers decried this habit, and gave it as a reason why they did not find it useful to mark pupils' homework.

Almost all the boarders did their homework in class while only 45% of the day scholars used the class to do assigned homework. More than a half of the day scholars did their homework in the sitting room or bedroom with the attendant problems of poor lighting, inconvenient writing surfaces, and distractions from other family members.

Further, more than a half of the students preferred to do homework in the early morning. Slightly more boarders than day scholars, and more girls than boys did their homework in the morning. Day-scholar girls were particularly disadvantaged on room, and the help they could get from colleagues in the evenings. Some few students commented that they did their mathematics homework in the morning depending on how ready they felt (tired, or fresh) – some said they would finish it in the evenings to prevent them from dozing while some said they preferred the morning since they felt fresher then.

On factors that motivated students to complete homework, it was found that more than half of the students who scored the top one third grades in KCSE mathematics chose 'love of mathematics'. This agrees with the findings about the relationship between attitudes in mathematics and achievement.

Facilities that limited students in doing homework were listed as textbooks, study guides and study space especially for day scholars. The meaning of 'study guide' was not defined yet 40% of the respondents chose this option. Whatever students meant with this word, it shows that many students encountered difficulty in mathematics homework which, they believed, could be solved by a study guide.

A large group of students mentioned that they found negative comments arising from homework discouraging. About three-quarters of those who complained about the comment 'poor' or 'weak' (possibly qualified with 'very'). Such

comments may have been given in good faith but students seemed to abhor the term in that it killed their morale to work any harder. Other comments that seemed to elicit strong pupil reactions were 'wake up' and 'be serious'. Perhaps students hated such exhortations because they seemed addressed at the individual rather than on performance on the homework.

Students seemed to equate expected success to be commensurate with the effort put, but were disappointed when the teacher 'refused' to associate success with the quantity of work put in. Teachers seemed to value completion of homework (81% of teachers agreed students must complete homework regardless of difficulty) and correctness of responses while students valued the effort they expended in mathematics homework regardless of the correctness of the answers arrived at. Unfortunately, teachers did not seem to be aware of this conflict. This may point to the need for teachers to understand students' problems in doing assigned homework. Otherwise, through homework, mathematics teachers could inadvertently encourage undesirable behaviour such as cheating and irresponsibility.

According to students the most popular methods of marking are teacher commenting on difficult problems asked by students, teacher marking each pupils book and students marking their work in that order. About 70 % of the students mentioned they would like mathematics teachers to comment on difficult problems arising from homework while only 50% mentioned they

desired their books to be marked by their teacher. Further only about one third of the students ranked first the method of teacher marking each pupils book.

A fraction of the students did not complete homework, a fact teachers seemed to be aware of. It was found that only 26% of the teachers reported that all their students finished assigned homework. That is, for 74% of the teachers, some students did not complete homework. Teachers knew that a fraction or all their students did not do or complete assigned homework, yet continued to give more homework. Most students reported that their teacher minded completion, yet did not still complete. Completion of homework was found to be related to how frequently it was marked. For non- completion, students were 'forced to complete immediately', 'punished', 'sent out of the lesson', or 'ignored' in that order. Teachers' and student responses to the question were similar except that teachers overstated 'reprimand' and understated 'punishment' in comparison to the students. Punishment for non-completion of homework was more likely to be used on Form 2 students than on Form 4 students.

The majority of students opined that their mathematics textbooks should have answers. More Form 4 students than Form 2 students, and more boys than girls required textbooks to have answers. Students were more likely to put a premium on textbook answers if they used textbooks for their own practice. Where teachers marked pupils work often enough, students were also less likely to see the need for textbook answers.

More than a half of the Form 4 students spent over one hour on homework assigned while more than a half of Form 2 students took up to an hour on assigned homework. This was attributed to the homework becoming more difficult or too much. About 35% and 45 % of Form 2 and Form 4 students respectively admitted to doing little or no mathematics work (homework or own practice). This seems to support KNEC 's (1995) statement that many students seem to have dropped mathematics as a subject. The students who reported to doing no (or little) mathematics work were similar from the gender and residence stratification.

Homework in mathematics was found to take a significant proportion of lesson time, which was typically 40 minutes long. Homework was noted to take an average of thirteen minutes (33%) of the mathematics lesson. In some classes, it would take even higher availing less time for the current lessons development. This way mathematics homework could even slow down instruction. Homework was given in the dying minutes of the lesson, and reviewed in the opening minutes of the subsequent lesson.

Self-rating of ability in mathematics seemed to decrease from Form 2 to Form 4, with more of the latter rating themselves poor. The mean self-rating seemed to be irrespective of the students boarding status. It also seems that boarding and day school girls were more homogenous in their self-rating than boys. It is noted peculiar that more boarding than day scholar girls rated themselves poor.

Most students knew that they had to make an effort (hard work) to succeed in mathematics. Girls were more likely than boys to attribute success in mathematics to intelligence (stable cause). More Form 2 than Form 4 students attributed success in mathematics to effort (unstable cause). This was likely to affect their willingness to put effort in daily mathematics work (homework).

The worst thing about mathematics homework, according to students, was too much work and working alone, and interestingly being proved weak. It was found that boys were more likely than girls to complain about the worst thing about mathematics homework as 'working alone' and proving them weak in mathematics. Form 4 girls reported an unusually low percentage for the problem of being proved weak by mathematics homework. Many students who answered a question on the most discouraging thing in mathematics homework, mentioned discouraging comments from teachers in marking their homework.

5.3 Conclusions

It was found that when homework was difficult, about three quarters of the students reported that they consulted their friends, and about one-fifth consulted the teacher. This indicates the importance of peers in the learning of mathematics, a structure that should be strengthened deliberately. Some schools encouraged a group approach to practice in mathematics and this seemed to have a positive effect on the students' attitude to homework. Friends of day scholars disperse after school and on weekends, and day scholars become disadvantaged in the extent to which they can consult friends in case of difficult homework.

Teachers should be consulted more often, but students complained that some mathematics teachers were unwilling, or were impatient in explaining difficult concepts to weak students. There were many comments to the effect that mathematics teachers should respect individual differences, and should be approachable.

From the many teachers' comments, mathematics teachers seemed to have a general feeling that average and poor students do not put adequate effort (perceived them as lazy) while the average and poor students felt neglected at the expense of the better students. Teachers, as is natural, take credit for their effort in guiding the good students, while blaming the poor performers for lack of interest and for not putting adequate effort in mathematics work. The poor performers made more comments implying that they would perform better if teachers took more time removing obstacles and arranging conducive environments for them to learn mathematics. We must also recall the synergistic, two-way reinforcing, effect of teacher effort and student performance. Teachers are encouraged by pupil efforts in doing assigned mathematics homework while students are encouraged by the teacher effort in marking and correction of such work.

The researcher got a feeling that the mathematics teachers sampled perceived themselves as trained to teach bright students. Perhaps their perception of their role as teachers of mathematics needs to be brought into tune with the reality in the schools and the nature of mathematics learning, and be advised on how to

pitch their teaching accordingly. This may be difficult since teachers have few excellent models to copy during their formative years. Their lecturers in the university are likely to use, as is usual, the lecture method, while their previous teachers and current senior teachers might be ingrained in old teaching habits, leaving student teachers of mathematics with few role models.

Mathematics performance in secondary schools sampled was found to be related to the general performance of the school. This indicates the importance of the quality of students in learning mathematics. It was noted that the very high achievers in the local day schools were likely to be some poor students who could not afford the fees for a boarding school to which they were initially invited. In Form 4, a high correlation between the schools' mathematics score and the general mean scores was found. This means that to raise performance in mathematics we must raise the general performance of the school.

Incidentally, even though all mathematics and science teachers were given a monetary inducement of two annual increments over their salaries in 1998, such increments may not serve to motivate teachers beyond making them feel special. Mathematics teachers are not likely to work harder in a staff-room where no one else is working, or is busy playing darts , scrabble or watching a favourite T.V programme. This has implications for the design of teacher workspaces, to ensure accountability and productivity of the teacher while in the school. Many of the mathematics Heads of Department had a space that they could use alone or with members of the department , but it seems that space is a

problem in many schools. Noisy staff-rooms where many, say, fifteen teachers are pooled are not ideal for marking of homework, or other serious preparatory work. Even with the increments, one anticipates the difficulty of a teacher trying to mark in a staff room where unmotivated teachers of other subjects, (c.f. Kamau, 2002: 102) are shouting and sharing social experiences. The total quality approach (for the whole school) would be a better starting point.

This has implications for the leadership of the school. What are the school Principal's main concerns for the school; public relations, physical development, economic viability, teachers' welfare, or academic focus? Not that these objectives are mutually exclusive but they serve to point out that the school Principal needs to set the academic environment right for all teachers to work. If so much time is taken on mathematics homework that is just busy work, performance in other subjects could actually be affected, since pupils would not have enough time to study other subjects, and yet they would not pass in mathematics.

It was also noted that some of the better performing schools in mathematics had an inducement for teachers to work harder, possibly a tradition, or monetary. Perhaps teachers might put a little more effort in managing homework if they worked with smaller groups or if they got a monetary inducement. Parenthetically, the issue of coaching, tuition is a very sensitive and controversial one in Kenya. Despite official statements that discouraged 'tuition', almost all schools visited (from interviews) had at least two extra

weeks of 'tuition', especially for Forms 3 and 4 during school recesses, the extra cost which was met by parents. The explanation given was that time during school term was limited and students needed extra time to complete the 8-4-4 syllabus, including Mathematics.

Syllabi of all subjects taught in a school cannot be equally lengthy, so coverage of the syllabus cannot be the only reason for calling back students during holidays to teach them all subjects. The extra holiday tuition might be tied to the pressure to excel in public examinations, and also on the fee paying ability of the students since most teachers would be unwilling to work during school holidays without a monetary inducement. This culture of parents paying something extra to teachers to teach their own students, the researcher is of the opinion, is counterproductive in the end, only serving to estrange teachers especially Mathematics' ones from the 'profession' attitude – going an extra mile when it is deemed necessary to do so.

It was observed that the responses of day scholars and boarders were different. More than a half of them did homework in less than ideal situations, and were less likely to receive help from colleagues for reasons already discussed. Day scholar students mentioned many impediments to doing homework some very basic, but beyond their control. Yet knowing our Kenyan secondary school admission process, many of the day scholars are the students who may need more help in mathematics. Thus, the playing ground in terms of the opportunity

to learn, does not seem to be level for boarding and day school students, and this problem needs to be addressed.

Homework was reported to take a substantial proportion of lesson time, and this could slow instruction in mathematics. In a 13 week term (and seven mathematics lessons a week), 13 minutes lost in a lesson would add up to 13 x 7 x 13 minutes or 29 lessons (a month of instruction time lost in a three month term). This does not seem to support the OFSTED (1995) or ILEA (Hargreaves) (1984) reports that contended that homework has the value of cutting down on instructional time. The homework practices observed with a homework-check-review formula used in many schools may, in fact, increase instructional time.

It is unlikely that mathematics homework in the form reported in many schools in this study can contribute much to improving performance in mathematics. Mathematics teachers need to take time to address some of the points raised by their students and discussed in this study. This way they can design homework that is intended to achieve more specific objectives than just 'practice'.

The homework pupils got was mostly ritualistic and did not appear to arise out of the need to achieve certain specific objectives, but was only vaguely assumed to result in more learning of mathematics. In many of the schools no teacher was available to supervise homework yet students were expected to do it everyday. On the worst thing about homework, a number of students remarked to the effect that it is "*when I find the mathematics homework hard, yet there*

is nobody to help me". The homework to many seemed to be failure prone, negatively reinforcing, only proving to the weak how poor they actually were through its difficulty or through teacher comments arising thereof. One Form 4 girl wrote the following:

> *maths homework makes me sick. Each time I can't get my sums right I want to cry, then I close my book and forget about it. I don't hate maths. I don't know why I just can't get it right." (girl, 27:4-11)*

Both teachers and students generally seem agreed that mathematics homework is important for various reasons such as feedback, practice, checking understanding and developing independence. Students also do not seem to mind homework that is given often. The only suggestions they made was that homework be made more purposeful, the quantity be reduced and quality improved, and that teachers patiently go over content that homework revealed to be inadequately mastered. The researcher is of the opinion that teachers only need some reorientation to newer and productive methods of teaching mathematics especially on the issue of homework, and to sensitisation on how their students feel about homework. There is also a case of helping mathematics teachers find more meaningfulness in their work. For example, only 9% of the teachers agreed that teaching mathematics was exciting to them, while 85% of them disagreed that they should check the homework they set. Ways must be found to address some of the teachers' concerns too.

Difficulty of mathematics especially through homework can discourage students. Mathematics teachers should teach in a way that does not emphasise the difficulty of mathematics but its usefulness. The efficacy of such a practice

was mentioned by one HOD mathematics, now a Principal, (T3.02) who gave testimony of how they were able to transform the grades of mathematics from the lowest to the highest grades. Homework, especially, should emphasise the heuristics of problem solving and the importance of presentation. Secondary school mathematics teachers emphasised that the answer to a problem is not as important (and emphasised that it does not earn many marks) as the method of working out the problem, but this seemed to be checked only during examinations, and tests.

Homework presents good opportunities for training students in desired methods, but this, the teacher can only do by becoming familiar with individual students' work, as in checking homework. Students preferred that their mathematics solve the problems on the chalkboard to other methods of checking homework. This in the whole might mean that many students were used to not having their work marked or they did not care or desire for such marking. Or did they not desire individualised attention (remember they also generally did not want differentiated mathematics homework)? This finding seems to agree with Abidha's (1996) finding that secondary school students seemed to prefer high structure in their learning environment. This finding, however, is surprising in that you would expect the students to want their books marked by the teacher. But as reported earlier, more students would rather the teacher solved the difficult problems arising from homework in class, a more impersonal (perhaps less threatening) method.

Teachers did not seem to view non-completion of homework, or copying of other students answers in order to complete as students did. Teachers viewed it

as deliberate in-subordination, or laziness while students gave other 'valid' reasons. Teachers and students were not agreed on the most important and worst thing about mathematics homework. Students reported the most important thing about homework to be feedback and learning to work mathematics alone. Teachers said that the most important thing was that it helps students practice concepts learned. The most popular student response on the worst thing about homework was that it took too much time, a complaint related to the amount of the homework, and the difficulty of working alone especially for day scholars. For teachers, the worst thing about homework was copying by students and that it was too much work for the teacher to mark. Teachers and students need to discuss on the why of homework before it is assigned.

Through homework mathematics, teachers can deliberately encourage (reinforce) their students to like mathematics, to put more time into it and perhaps improve in mathematics generally. Quite a number of students in this study complained of discouraging remarks that emanated from the marking of mathematics homework. Such comments are likely to discourage than encourage pupils in mathematics.

Teachers have a gap to bridge in terms of accessibility by students in difficulty. If the pupils perceive a teacher harsh, they are unlikely to approach him(her) when they encounter difficulty in mathematics and homework. Students made many comments about how mathematics homework could be better organised, and how they could be taught mathematics better. Many of the comments made were surprising for they sounded like they were from some Mathematics

Education College, showing, perhaps, that students have a feeling that mathematics could be taught better. This study concludes with a remark from one such student who wrote:

> *Teachers have a big bearing on a student's performance. Her predictions, her answers to student questions can either sow a negative or positive seed. Teachers should be particular on how they handle weak students in class. (Girl, 23:4-2).*

5.4 Recommendations of the study

1. There is urgent need to get a Homework Master in a school (or to recognise the importance and function of) to monitor, co-ordinate the amount and quality of homework in a school between departments. Pupils who don't finish their work could be referred to such a person. The guidance and counselling teacher or Director of Studies office could perform such a function. Such a teacher could walk around to ensure pupils are left with a teacher to guide them if necessary.
2. There should be community study centres for day scholars to mediate, and equalise the effects of the home. Rural electrification may help in such efforts. Such centres could stock some common books for mathematics. Members of the community could organise how to supervise such study. This could be done through community initiative. The day schools can lead in such activities by opening up their facilities to their students and community after official school hours.
3. Since mathematics homework is such an important aspect of mathematics teaching and learning, there is need to sensitise teachers about how students feel about homework. When teachers and students share the same value on for the importance of homework, and the limitations of both parties in

completing and marking homework, more is likely to be achieved. The researcher recognises the importance of initiatives such as SMASSE towards the improving performance in mathematics in the country.

4. The formation of a voluntary national association of Mathematics teachers to which teachers could be affiliated would help in improving the standards of mathematics teaching (including homework) in the country. Such an organisation could require continuing professional education. This in turn would get mathematics teachers to continue experiencing the thrills and frustration of doing mathematics. This would also provide teachers with a forum for sharing tried out models on desirable efficient practices in mathematics teaching. The author appreciates the role of the local mathematics associations at the district level in raising the standards of mathematics in schools.
5. It is suggested that more emphasis be put on suitable homework and remedial teaching models in training future mathematics teachers so that their learners would perceive them as more approachable and helpful.
6. There is need for schools to check the progress of their students in learning mathematics. An enabling environment with an appropriate teaching load should be created where mathematics teachers can spend more of their time on task, especially on marking pupils work towards remediation of the learners experiencing difficulties.

5.5 Recommendations for Further Research

- It is recognised that variables may be related directly or through an intervening variable, and that relationships may not be so clear due to the

effect of confounding variables. There is need to conduct more studies especially on relationships suggested in this study. For example, on the frequency of assigning and marking homework; self concept /self rating in mathematics; teaching load and feedback strategies; and achievement in mathematics to be able to make more definite statements about variables that are associated and the mechanisms of such relationships.

- This study was based in the secondary school. There should be a comparable study to find out the organisation of mathematics homework in primary schools to see if practices are compatible with the secondary school. This would help mathematics teacher in secondary schools to build continuity with the primary school for the benefit of students.
- More thorough studies on a few or one school may help us know the subtle points in homework management. The instruments should be improved on to fit a case study of one or a few schools of known mathematics performance.
- There is need for studying the details of how CAT and own practice contribute to achievement in mathematics. Do CATs bridge the gaps that seem to be left by mathematics homework?
- The researcher got a feeling that the Principal has a big role to play in the academic culture of the school. How does a principal with Mathematics teaching background affect students' interest and performance of that subject in the school? What is the relationship between the leadership styles of the principal and the relative performance of the school?

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APPENDICES

APPENDIX A

INTERVIEW SCHEDULE FOR SCHOOL HEADS/ DEPUTY

1. Introduction. Acquaintance and Statement on study

2. Comments on general pupil KCSE performance

3. Perceived causes of success/failure especially contribution of homework

7. Any school guidance to teachers, students on homework and tuition? Examples

5. Presence of feedback provision on homework

8. Any homework policy?

9. Does the school require any minimum achievement standards before promotion to next class?

7. Other specific observations on homework in the school

APPENDIX B

HOMEWORK OBSERVATION SCHEDULE

1. Does the teacher have a lesson plan. and is homework planned for?

5. Homework structuring activities by the teacher, say, explanations, exhortations and statements of expectation on completed work

3. Is there a Review or comments on previous homework?

10. spot checks of students' mathematics exercise books to confirm frequency of homework, and marking

11. Kinds of homework given: Exploratory, drill, reading/working ahead, revision

12. Time taken on homework

APPENDIX C

TEACHER QUESTIONNAIRE

Dear colleague

This questionnaire hopes to benefit from your experience in teaching mathematics by getting your views on homework. There are no correct answers expected. Your responses will be treated confidentially and pooled with those from other secondary school mathematics teachers. Your sincere views and suggestions will contribute highly to coming up with a collective view on this topic.

Name (optional)

Gender ( ) M ( ) F

Teaching Experience (years) ----------

Number of mathematics classes taught .....

How long have you been with this **Form 2** or **Form 4** class? .....terms

1. How often do you give homework?
   ( ) weekly ( ) after every lesson
   ( ) once a month ( ) never

2. To which students do you give homework?
   ( ) slow learners ( ) all students
   ( ) bright students ( ) naughty students

3. What kinds of homework do you give often?
   ( ) practice on content covered ( ) reading ahead
   ( ) extension beyond content ( ) creative work
   ( ) any other ....Please specify.....

4. How much homework do you give to be done in school holidays?
   ( ) none ( ) some ( ) a lot

5. Do you find it practical to plan ahead for homework to be assigned?
   ( ) no
   ( ) yes (please specify how you do).....
   .....

6. Where do you assign homework from?
   ( ) class textbooks ( ) chalkboard
   ( ) library textbooks ( ) handouts
   ( ) past papers ( ) other (specify).....
   .....

7. Generally, what proportion of your class finish homework assigned?

   ( ) all ( ) 3/4 ( ) 1/2 ( ) none

8. What would you do if students do not complete assigned homework?
   ( ) Ignore and continue with the lesson ( ) punish the culprits
   ( ) reprimand them ( ) insist that they first complete it

( ) send the culprits out of class ( ) assign more homework

9. When do you provide answers to assignments given?
( ) not at all ( ) before the assignment
( ) in the following lesson ( ) any other (please specify) -
.....

10. When do you discuss any homework issues with the students?
( ) at beginning of following lesson ( ) at end of following lesson
( ) in students time such as prep ( ) individually to those who are interested
( ) not at all ( ) during class as homework is assigned

11. Generally how long do you think students take on your mathematics homework in a day?
( ) half hour ( ) 1 hour ( ) 1 .5 hours ( ) 2 hours or over

12. How often do you find it useful to mark pupils' homework?
( ) all homework ( ) once a week ( ) once a month ( ) occasionally

13. How soon do you find it practical to return any marked homework?
( ) the same day ( ) by the next lesson
( ) by end of the week ( ) not applicable

14. Which method do you find the most practical in analysing homework ?
( ) on the chalkboard as students mark their work
( ) on the chalkboard as students exchange exercise books
( ) comment/solve difficult problems asked by students
( ) mark each pupil's work
( )other (suggest).....

15. Who in your school makes decisions about how much homework is given to students?
( ) form master ( ) individual teacher
( ) departmental head ( ) parents
( ) principal (school policy) ( ) students
( ) other (specify).....

16. Does your school require that you help students in your own time?
( ) Yes ( ) no

17. What students do you give such help?
( )those seeking help ( ) all ( ) weak
( ) average ( ) bright ( ) weak and bright

19. How would you generally rate your students in their potential to perform highly in KCSE mathematics examination?
( ) excellent ( ) good ( ) average ( ) poor
A B C D/E

20. what do you find to be the biggest hindrance to marking maths homework in your school
( ) lack of marking space ( ) poor students
( ) big teaching load ( ) personal interest
( ) any other (specify)

21. What is the worst thing about mathematics homework?

Please indicate how much you agree with the following ideas

Note: **SA** = Strongly Agree
A = Agree
U = Undecided
SD = Strongly Disagree
D = Disagree

1. The mathematics teacher must assign homework to cover the syllabus
   SA..... A..... U..... D ..... SD .....
2. With efficient teaching teachers need not assign homework
   SA..... A..... U..... D ..... SD.....
3. Marking homework is an enjoyable task for the maths teacher.
   SA..... A..... U..... D..... SD.....
4. Students can pass KCSE mathematics even without doing homework
   SA.... A..... U..... D..... SD.....
5. Mathematics teachers should supervise homework as it is done
   SA.... A.... U.... D..... SD....

6. Homework widens the gap between the bright student and the slow learner
   SA..... A..... U..... D..... SD.....
7. Maths homework is a waste of students time
   SA..... A..... U..... D..... SD.....

8. There is no point giving homework to poor students
   SA..... A..... U..... D..... SD.....
9. Students who don't do homework correctly should be punished
   SA..... A..... U..... D..... SD.....
10. Teaching mathematics is an exciting task
    SA..... A..... U..... D..... SD.....
11. Setting homework is an easy task
    SA..... A..... U..... D..... SD.....

12. Students should have a say in the choice of homework assigned.
    SA..... A..... U..... D..... SD.....
13. Students must do maths homework every day to succeed in KCSE maths.
    SA..... A..... U..... D..... SD.....

14. All homework must be checked by the teacher
    SA..... A..... U..... D..... SD.....
15. Students must complete homework whether it is difficult or not
    SA..... A..... U..... D..... SD.....

16. Homework is a way to keep students busy
    SA..... A..... U..... D..... SD.....
17. Students learn more in homework than from the maths class.
    SA..... A..... U..... D..... SD.....

18. A maths teacher should do the homework he assigns to students
    SA..... A..... U..... D..... SD.....
19. Students must repeat all the problems they get wrong in maths homework
    SA..... A..... U..... D..... SD.....
20. Maths homework should be reduced in schools
    SA..... A..... U..... D..... SD.....

21. The best thing about homework is .....
.....
.....

22. What factor(s) do you consider in deciding on the amount and kind of homework to assign?.....
.....

23. What kind(s) of remedial help do you give in maths?

24. ANY OTHER COMMENT(S) ON MATHEMATICS HOMEWORK

Thank you for your help

Mr. B. Ngaruiya
University of Nairobi

APPENDIX D

STUDENTS QUESTIONNAIRE

Dear student,
You have been chosen to participate in this research which seeks to get your views on **Mathematics homework** in Kenyan secondary schools. This is not a test and as such there are no right or wrong answers. Your most sincere view is all required. Further, what you write here is confidential and will not be shown to your teacher or any other person. Your answers will be mixed with those of other students to make suggestions on homework organisation in Kenya.

Where possible put a tick (√) against the answer that describes your view. If you think that more than one answer is applicable, tick them and rank them(e.g. 1st, 2nd,etc). If none fits in, please feel free to add other comments.

NAME .....CLASS..... ..... SCHOOL.....

GENDER ( ) M ( ) F AGE -------(yrs) boarder ( ) day scholar ( )

SECTION I

1.How often does your mathematics teacher give homework?
( ) Never ( ) every lesson
( ) weekly ( ) once a month

2. How would you describe the maths homework you get?
( ) very difficult ( ) difficult
( ) okey ( ) easy

3. Do you receive the same homework like other pupils in the class?
( ) yes ( ) no
Please explain.....

4. How would you rate yourself in maths performance?
( ) very good ( ) good
( ) average ( ) poor

5. Does your mathematics teacher mind whether homework is finished or not?
( ) yes ( ) no

6. what does your teacher do if some students do not complete homework?
( ) Ignore and continue with the lesson ( ) give more homework
( ) punish the culprits ( ) send the culprits out of class
( ) reprimand them ( ) insist that they first complete it

7.Why do some students not complete homework?
( ) too much maths homework is given ( ) the students are lazy
( ) the teacher does not mind ( ) the homework is difficult
( ) total amount of homework is a lot ( ) time is not enough due to other work
( ) other (please add) .....
.....

8. How often is your maths homework marked ?
( ) Never. ( )once a month ( ) once a week ( ) all homework

9. Which of the following marking methods should be used for you to know whether you are right or wrong? Number them in order of your preference.
( )on the chalkboard as students mark their work
( ) on the chalkboard as students exchange exercise books
( ) comment/solve difficult problems asked by students
( ) mark each pupil's work
( ) students mark their own work form textbook answers
( )other (suggest).....

10. Which of the following kinds of marking maths homework do you find useful?
( ) just ticks or 'wrongs' ( ) marks eg. 10/20
( ) grades eg A . B. C etc. ( ) written comments only
( ) marks or grades and teacher comments
( ) comments on individual work in class
( ) other -add .....

11. what in mathematics homework discourages you most?
please explain.....
.....

12. Should mathematics textbooks contain answers?
( ) yes ( ) no

13. On average. how long do you take to complete maths homework given in the day?
( ) half hour ( ) 1 hour ( ) 1 .5 hours ( ) 2 hours

14. If a problem in homework is too difficult what do you do?
( ) copy from a friend ( ) ignore it
( ) ask for help ( ) guess to complete it
( ) make further reference from books
other (specify).....

15. Do you usually require assistance with homework?
. ( ) yes ( ) no If yes. who helps with it?
( ) friends ( ) parents ( ) teacher ( ) other(specify).....

16.Which of the following factors helps you most to complete your mathematics homework?
( ) parental pressure ( ) pressure from teacher
( ) love of mathematics ( ) type of homework
( ) personal goals ( ) success of close people

17. Where do you usually do your homework?
( ) class ( ) dormitory ( ) sitting room
( ) bed room ( ) Library ( ) outside
( )other place.. state.....

18. When do you find it good to do maths homework?
( ) early morning ( ) late morning ( )afternoon ( )evening ( ) night

19. Which facilities limit your good performance in maths homework?
( ) study desk ( ) reference books ( ) textbooks ( ) enough light
( ) writing materials ( ) study guide ( ) study room ( ) other

20. Some students pass highly in mathematics examinations. Which **two** of the following factors do you think are the most important?

( ) intelligence ( ) personal effort
( ) school facilities ( ) luck
( ) teacher

21. What do you think is the most important use of homework?

( ) checking how clever a student is ( ) students learn to work on their own
( ) help students know where they go wrong ( ) help students pass KCSE
( ) foster understanding of maths ( ) practice skills learnt
( ) other. Please add:.....

22. What do you think is the worst thing about maths homework

( ) one has to work alone
( ) It proves that one cannot learn maths
( ) It requires too much time to complete it
( ) it does not reward the students' effort enough
( ) other. Please state .....

22. On the amount of time you spend in mathematics work, which of the following would you say is true?

( ) I spend more time on homework than on practising alone
( ) I spend more time practising alone than on maths homework
( ) I spend the about the same time on own maths work as homework
( ) I do not spend any time on maths homework or working alone

SECTION 2

Indicate the **extent to which you agree** with the following ideas on **mathematics homework**. Choose only one answer for each statement.

key:**SA = strongly Agree, A = Agree, U = undecided D = disagree SD = strongly disagree**

1. Learning Mathematics is fun
   SA A..... U.... D..... SD.....
2. Mathematics homework is boring
   SA..... A.... U..... D..... SD....
3. Difficult homework discourages me
   SA..... A.... U..... D..... SD.....
4. students are overloaded with maths homework
   SA.... A.... U..... D.... SD.....
5. There is no point in teachers marking mathematics homework
   SA.... A.... U..... D..... SD....
6. If homework is difficult one should copy answers from a friend
   SA.... A.... U..... D..... SD....
7. Homework in mathematics makes me feel stupid
   SA.... A..... U..... D..... SD.....
8. I prefer doing my own maths prep work to doing homework
   SA.... A.... U.... D..... SD.....
9. I enjoy doing mathematics homework
   SA.... A.... U..... D..... SD.....
10. Students must do homework every day for them to succeed in mathematics
    SA.... A..... U..... D..... SD.....

11. Homework helps a student learn to work independently (alone)
SA..... A..... U..... D..... SD.....
12. It is enjoyable working alone on homework
SA..... A..... U..... D..... SD.....
13. Students should receive lots of mathematics homework for success in KCSE
SA..... A..... U..... D..... SD.....
14. Those who fail to do maths homework correctly should be punished.
SA..... A..... U..... D..... SD.....

15. Learning maths is easy for hardworking students
SA..... A..... U..... D..... SD.....
16. Poor maths students should not get any homework
SA..... A..... U..... D..... SD.....
17. Passing KCSE mathematics is mostly a matter of luck.
SA..... A..... U..... D..... SD.....
18 Many times, students know the purpose of maths homework
SA..... A..... U..... D..... SD.....

19. Students enjoy doing homework set from a page in their textbook
SA..... A..... U..... D..... SD.....
20. Students need to be supervised at times when they do their homework
SA..... A..... U..... D..... SD.....
21. Doing maths homework is a waste of time
SA..... A..... U..... D..... SD.....
22. We need more mathematics homework in my class
SA..... A..... U..... D..... SD.....

23. Maths homework is a way to keep students busy
SA..... A..... U..... D..... SD.....
24. I learn more from the maths homework than from the maths class
SA..... A..... U..... D..... SD.....
25. Students should be involved in choosing homework to be done.
SA..... A..... U..... D..... SD.....
26. In homework one usually repeats the same things.
SA..... A..... U..... D..... SD.....

27. Students in the same class should receive different homework.
SA..... A..... U..... D..... SD.....
28. Students must repeat/correct all problems they get wrong
SA..... A..... U..... D..... SD.....
29. Students who are good in maths should be given more homework
SA..... A..... U..... D..... SD.....
30. Getting problems right or wrong in maths homework is not important
SA..... A..... U..... D..... SD.....

31. ANY OTHER COMMENTS YOU WOULD LIKE TO ADD ON MATHS HOMEWORK

Thank you for your views

Mr. B. Ngaruiya
University of Nairobi

APPENDIX E
KCSE 2000 MATHEMATICS PAPERS

Name ..... Index Number ..... / .....

121/1
MATHEMATICS
Paper 1
Oct./Nov. 2000
2½ hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

Kenya Certificate of Secondary Education

MATHEMATICS

Paper 1

2½ hours

Instructions to candidates.

1. *Write your name and index number in the spaces provided at the top of this page.*
2. *The paper contains two sections: Section I and Section II.*
3. *Answer all the questions in Section I and any six questions from Section II.*
4. *All aaswers and working must be written on the question paper in the spaces provided below each question.*
5. *Marks may be given for correct working even if the answer is wrong.*
6. *Electronic calculators must not be used. Mathematical Tables are provided.*

For Examiner's use only.

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total

Section II

17	18	19	20	21	22	23	24	Total

Grand Total

This paper consists of 19 printed pages

Candidates should check the question paper to ensure that all the printed pages are printed as indicated and no questions are missing.

SECTION I (52 marks)

Answer **all** *the questions in this section.*

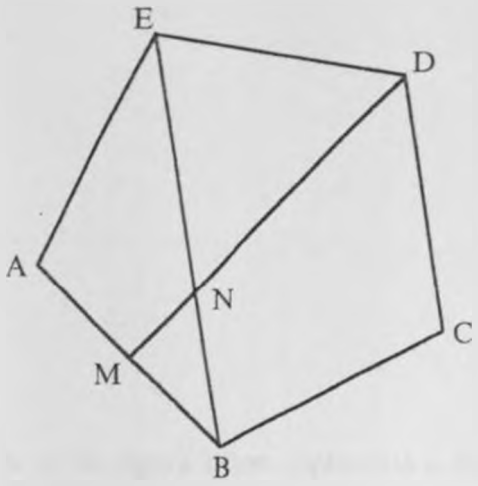
Evaluate

$$\frac{28 - (^{-}18)}{^{-}2} - \frac{15 - (^{-}2)(^{-}6)}{3}$$ (3 marks)

Simplify the expression

$$\frac{3a^2 + 4ab + b^2}{4a^2 + 3ab - b^2}$$ (3 marks)

In the figure below, ABCDE is a regular pentagon and M is the midpoint of AB.
DM intersects EB at N.



Find the size of:

(*a*) $\angle BAE$ (1 mark)

(*b*) $\angle BED$ (1 mark)

(*c*) $\angle BNM$. (1 mark)

The table below shows heights of 50 students.

Height (cm)	Frequency
140–144	3
145–149	15
150–154	19
155–159	11
160–164	2

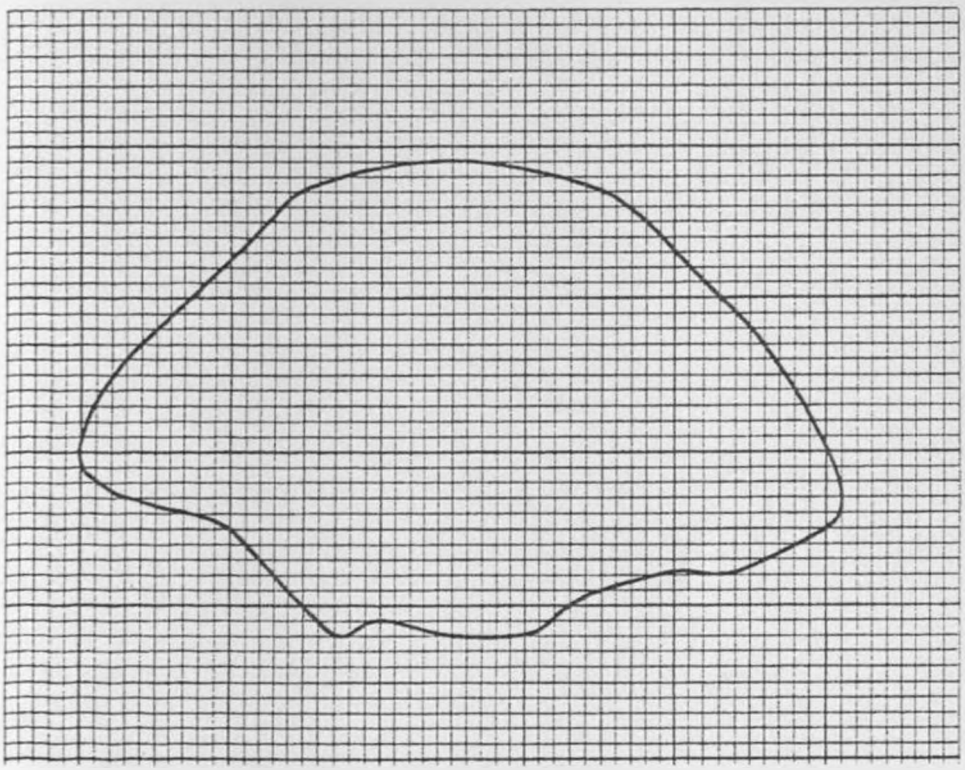
(*a*) State the modal class. (1 mark)

(*b*) Calculate the median height. (2 marks)

5 Find the value of x that satisfies the equation.

$$\log (x + 5) = \log 4 - \log (x + 2)$$ (3 marks)

6 The enclosed region shown in the figure below represents a ranch drawn to scale. The actual area of the ranch is 1075 hectares.



(*a*) Estimate the area of the enclosed region in square centimetres. (1 mark)

(*b*) Calculate the linear scale used. (2 marks)

Given $\sin \theta = \frac{2}{3}$ and θ is an acute angle find.

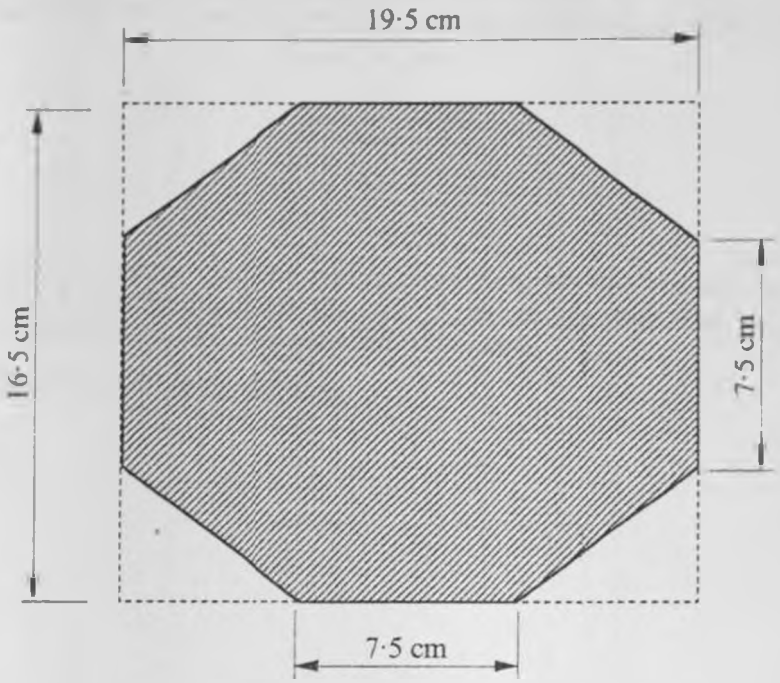
(*a*) $\tan \theta$, giving your answer in surd form (2 marks)

(*b*) $\sec^2 \theta$. (1 mark)

Shopping centres X, Y, and Z are such that Y is 12 km south of X and Z is 15 km from X. Z is on a bearing of 330° from Y.

Calculate the bearing of Z from X. (3 marks)

9 The figure below shows an octagon obtained by cutting off four congruent triangles from a rectangle measuring 19·5 cm by 16·5 cm.



Calculate the area of the octagon. (3 marks)

10 The length and breadth of a rectangular paper were measured to the nearest centimetre and found to be 18 cm and 12 cm respectively.

Find the percentage error in its perimeter. (3 marks)

11 A pyramid VABCD has a rectangular horizontal base ABCD with AB = 12 cm and BC = 9 cm. The vertex V is vertically above A and VA = 6 cm. Calculate the volume of the pyramid.

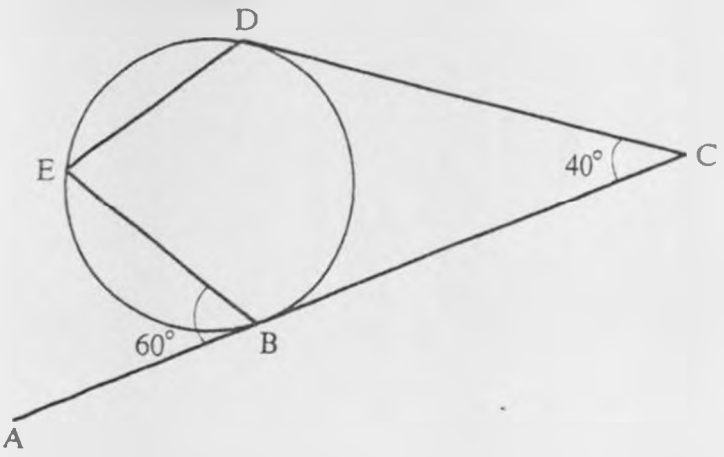
(2 marks)

12 A tailor intends to buy a sewing machine which costs Ksh. 48,000. He borrows the money from a bank. The loan has to be repaid at the end of the second year. The bank charges an interest at the rate of 24% per annum compounded half-yearly.

Calculate the total amount payable to the bank.

(4 marks)

13 On the figure below lines ABC and DC are tangents to the circle at B and D respectively. $\angle ACD = 40°$ and $\angle ABE = 60°$.



Giving reasons find the size of:

(a) $\angle CBD$

(2 marks)

(b) $\angle CDE$.

(2 marks)

14 The acceleration a m/s^2 of a particle moving in a straight line is given by $a = 18t - 4$, where t is time in seconds. The initial velocity of the particle is 2 m/s.

(*a*) Find the expression for velocity in terms of t. (2 marks)

(*b*) Determine the time when the velocity is again 2 m/s. (1 mark)

15 Three people Korir, Wangare and Hassan contributed money to start a business. Korir contributed a quarter of the total amount and Wangare two fifths of the remainder. Hassan's contribution was one and a half times that of Korir. They borrowed the rest of the money from the bank which was sh. 60,000 less than Hassan's contribution. Find the total amount required to start the business. (4 marks)

Karani bought 4 pencils and 6 biro-pens for sh. 66 and Tachora bought 2 pencils and 5 biro-pens for sh. 51.

(*a*) Find the price of each item. (3 marks)

(*b*) Musoma spent sh. 228 to buy the same type of pencils and biro-pens. If the number of biro-pens he bought were 4 more than the number of pencils, find the number of pencils he bought. (2 marks)

SECTION II (48 marks)

Answer any **six** *questions from this section.*

17 A triangular plot ABC is such that AB = 36 m, BC = 40 m and AC = 42 m.

(*a*) Calculate the:

(i) area of the plot in square metres (3 marks)

(ii) acute angle between the edges AB and BC. (3 marks)

(*b*) A water tap is to be installed inside the plot such that the tap is equidistant from each of the vertices A, B and C. Calculate the distance of the tap from vertex A. (2 marks)

18 In a Form I class there are 22 girls and 18 boys. The probability of a girl completing the secondary education course is $\frac{3}{5}$ whereas that of a boy is $\frac{2}{3}$.

(*a*) A student is picked at random from the class. Find the possibility that.

(i) the student picked is a boy and will complete the course. (2 marks)

(ii) the student picked will complete the course. (2 marks)

(*b*) Two students are picked at random. Find the probability that they are a boy and a girl and that both will not complete the course. (4 marks)

19 (*a*) Complete the table below for the equation:

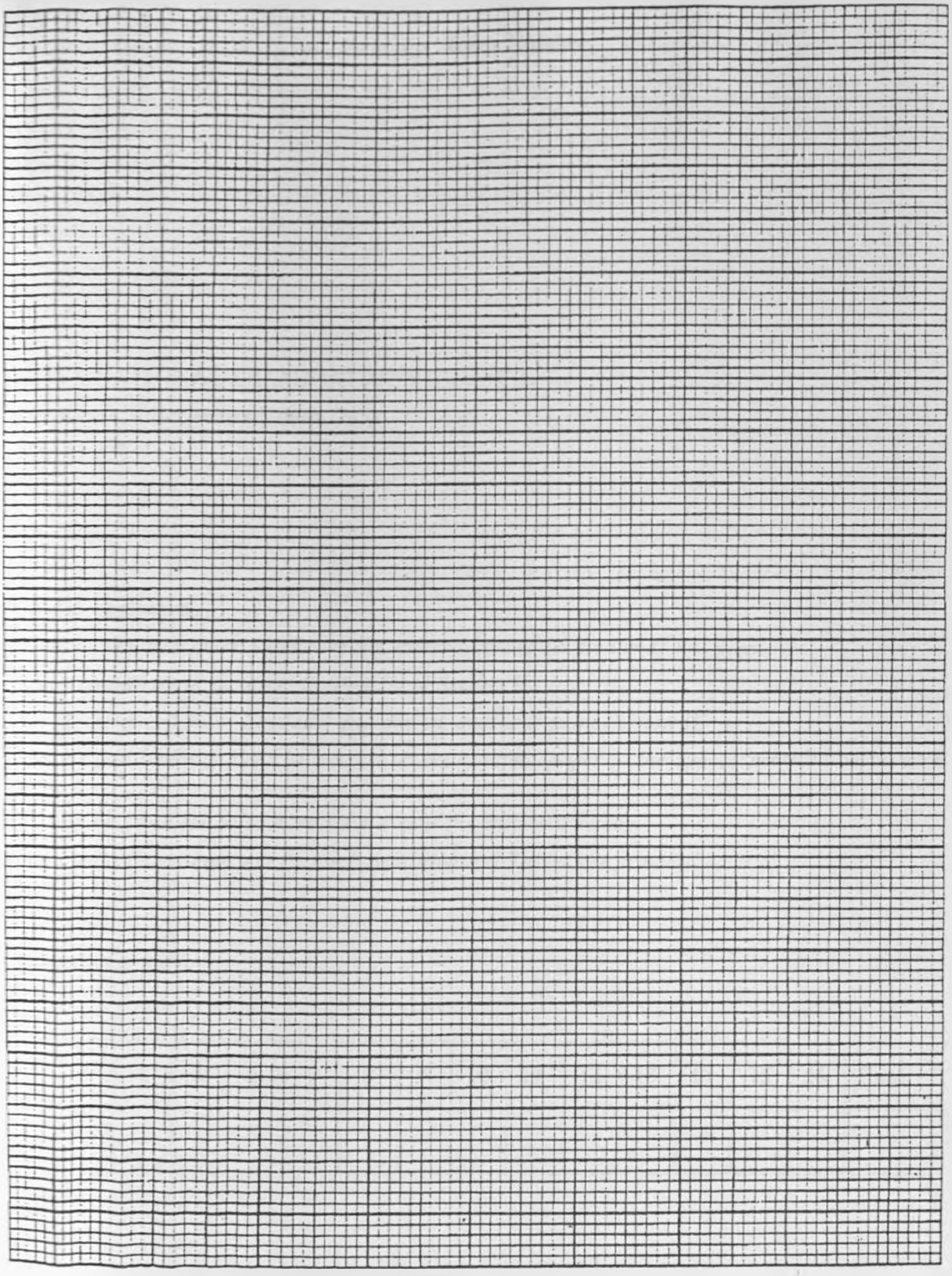
$$y = 2x^3 + 5x^2 - x - 6.$$ (2 marl

x	–4	–3	–2	–1	0	1	2
$2x^3$	–128	–54			0	2	16
$5x^2$	80	45	20	5	0	5	20
$-x$	4	3			0	–1	
–6	–6	–6	–6	–6	–6	–6	–6
y	–50				–6	0	

(*b*) On the grid provided draw the graph $y = 2x^3 + 5x^2 - x - 6$ for $-4 \leq x \leq 2$. Use 2 cm represent 1 unit on x-axis and 1 cm to represent 5 units on the y-axis. (3 marl

(*c*) By drawing a suitable line use the graph in (*b*) to solve the equation.

$$2x^3 + 5x^2 + x - 4 = 0.$$ (3 mar



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121/2
THEMATICS
Paper 2
ct./Nov. 2000
2½ hours

E KENYA NATIONAL EXAMINATIONS COUNCIL
ya Certificate of Secondary Education
THEMATICS
per 2
hours

tructions to candidates.

Write your name and index number in the spaces provided at the top of this page.

The paper contains ***two*** *sections:* ***Section I*** *and* ***Section II****.*

Answer ***all*** *the questions in* ***Section I*** *and any* ***six*** *questions from* ***Section II****.*

All answers and working must be written on the question paper in the spaces provided below each question.

Marks may be given for correct working even if the answer is wrong.

Electronic calculators ***must not*** *be used. Mathematical Tables are provided.*

r Examiner's use only.

ction I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total

ction II

17	18	19	20	21	22	23	24	Total

Grand Total

This paper consists of 17 printed pages.

Candidates should check the question paper to ensure that all the printed pages are printed as indicated and no questions are missing.

SECTION I (52 marks)

Answer **all** *the questions in this section.*

Find the equation of the perpendicular to the line $x + 2y = 4$ and passes through point (2, 1). (2 marks)

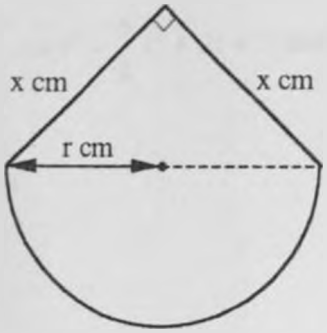
A passenger noticed that she had forgotten her bag in a bus 12 minutes after the bus had left. To catch up with the bus, she immediately took a taxi which travelled at 95 km/h. The bus maintained an average speed of 75 km/h. Determine

(*a*) the distance covered by the bus in 12 minutes. (1 mark)

(*b*) the distance covered by the taxi to catch up with the bus. (2 marks)

Two sides of a triangle are 5 cm each and the angle between them is 120°. Calculate the area of the triangle. (3 marks)

A piece of wire, P cm long, is bent to form the shape shown in the figure below.



The figure consists of a semicircular arc of radius r cm and two perpendicular sides of length x cm each.

Express x in terms of P and r. (1 mark)

hence show that the area A cm^2, of the figure is given by

$$A = \frac{1}{2}\pi r^2 + \frac{1}{8}(P - \pi r)^2.$$ (2 marks)

5 The distance from a fixed point of a particle in motion at any time t seconds is given by

$$s = t^3 - \frac{5}{2}t^2 + 2t + 5 \text{ metres.}$$

Find its:

(*a*) acceleration after t seconds (1 mark)

(*b*) velocity when acceleration is zero. (2 marks)

6 Find all the integral values of x which satisfy the inequalities

$$2(2 - x) < 4x - 9 < x + 11.$$ (3 marks)

Akinyi, Bundi, Cūra and Diba invested some money in a business in the ratio of 7:9:10:14 respectively. The business realised a profit of sh. 46,800. They shared 12% of the profit equally and the remainder in the ratio of their contributions.

Calculate the total amount of money received by Diba. (3 marks)

Solve the equation

$$2\sin^2(x - 30°) = \cos 60°$$

for $-180° \leq x \leq 180°$. (3 marks)

A triangle is formed by the coordinates A(2, 1), B(4, 1) and C(1, 6). It is rotated clockwise through 90° about the origin.

Find the coordinates of this image. (3 marks)

10 Three representatives are to be selected randomly from a group of 7 girls and 8 boys. Calculate the probability of selecting two girls and one boy. (3 marks)

11 Use logarithms to evaluate (4 marks)

$$\sqrt[3]{\frac{1 \cdot 23 \times 0 \cdot 0089}{76 \cdot 54}}$$

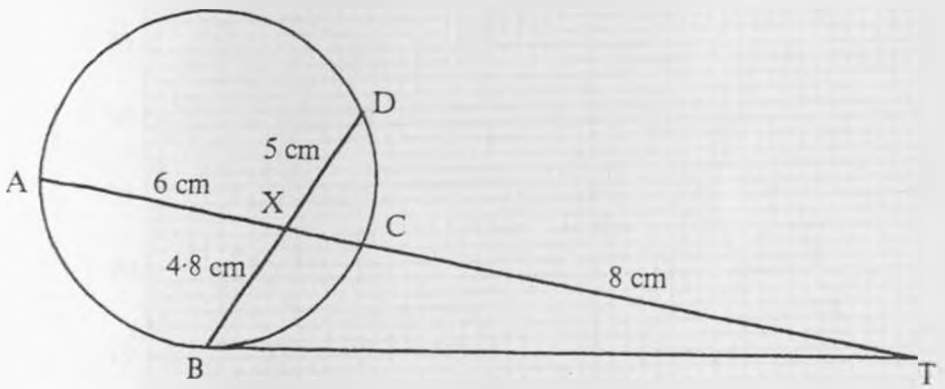
12 Find the values of x which satisfy the equation

$$5^{2x} - 6 \times 5^{x} + 5 = 0.$$ (4 marks)

Expand $(1 + x)^5$,

hence, use the expansion to estimate $(1\cdot04)^5$ correct to 4 decimal places. (4 marks)

In the figure below, BT is a tangent to the circle at B. AXCT and BXD are straight lines. AX = 6 cm, CT = 8 cm, BX = 4·8 cm and XD = 5 cm.



Find the length of

(*a*) XC. (2 marks)

(*b*) BT. (2 marks)

15 Make x the subject of the formula

$$P = \left(\frac{xy}{z + x}\right)^{\frac{1}{2}}.$$

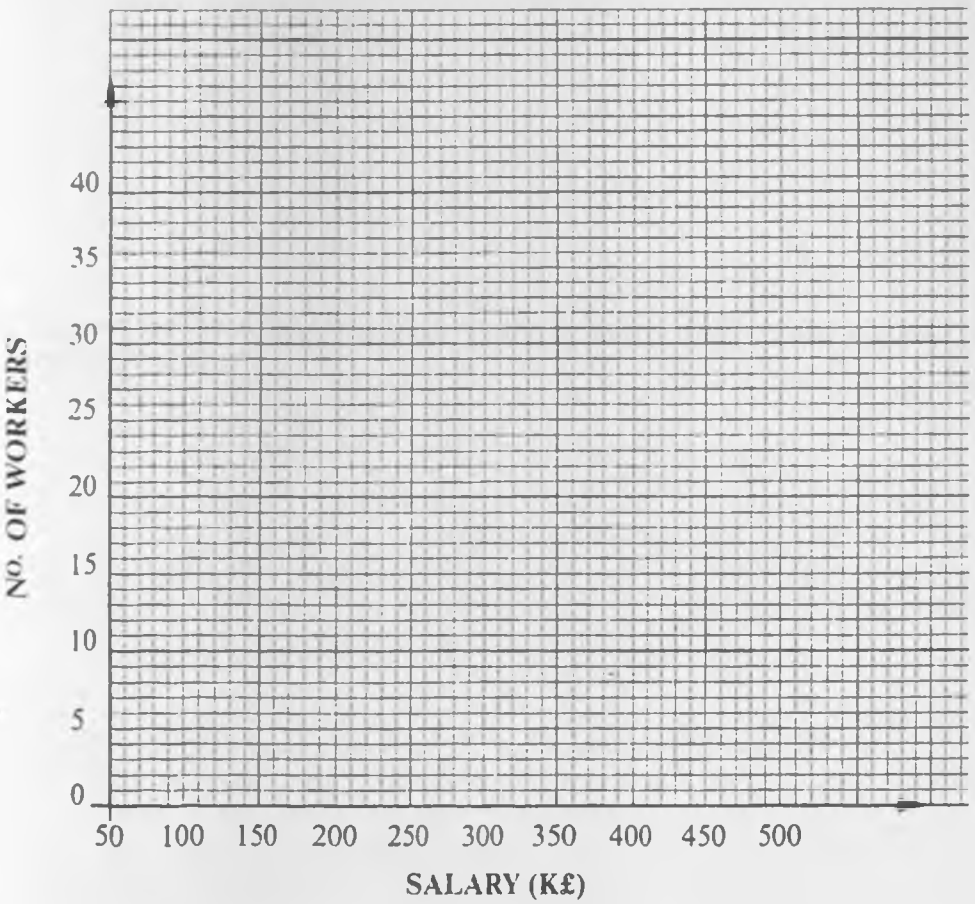
(4 marks)

16 The frequency distribution table below shows the weekly salary (K£) paid to workers in a factory.

Salary (K£)	$50 \leq x < 100$	$100 \leq x < 150$	$150 \leq x < 250$	$250 \leq x < 350$	$350 \leq x < 500$
Number of workers	13	16	38	24	9

On the grid provided below, draw a histogram to represent the information shown above.

(3 marks)



SECTION II (48 marks)

Answer any **six** *questions from this section.*

A construction company requires to transport 144 tonnes of stones to sites A and B. The company pays sh. 24,000 to transport 48 tonnes of stone for every 28 km. Kimani transported 96 tonnes to site A, 49 km away.

(*a*) Find how much he was paid. (3 marks)

(*b*) Kimani spends ksh. 3,000 to transport every 8 tonnes of stones to site A. Calculate his total profit. (2 marks)

(*c*) Achieng transported the remaining stones to site B, 84 km away. If she made 44% profit, find her transport cost. (3 marks)

18 The eleventh term of an arithmetic progression is four times its second term. The sum of the first seven terms of the same progression is 175.

(*a*) Find the first term and the common difference of the progression. (4 marks)

(*b*) Given that the p^{th} term of the progression is greater than 124, find the least value of P. (4 marks)

19 A rally car travelled from point R to point S. S is 128 km on a bearing 060° from R. The car then set off from S at 9.30 am towards T at an average speed of 150 km/h. It was expected at T at 11.30 am. After travelling for 1 hour and 20 minutes it broke down at point P.

The bearing of T and P from S is 300°.

(*a*) Calculate the:

(i) distance from R to P (4 marks)

(ii) bearing of P from R. (3 marks)

(*b*) The repair took 10 minutes and the car set off to complete its journey to T.

Find the speed at which the car must now move to reach T on time. (1 mark)

The charge, C shillings per person for a certain seminar is partly fixed and partly inversely proportional to the total number N of people.

(*a*) Write down an expression for C in terms of N. (1 mark)

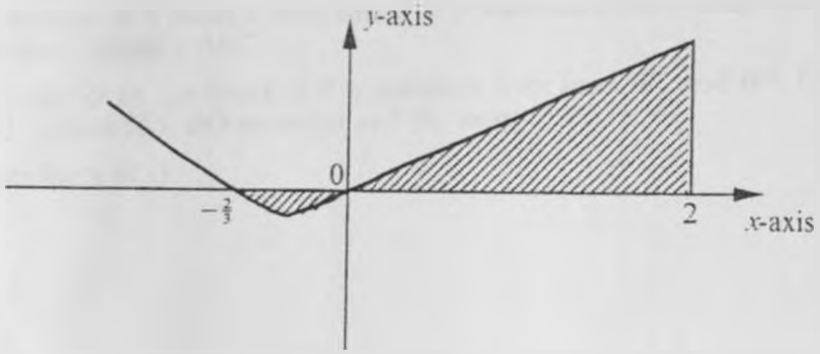
(*b*) When 100 people attended the charge is sh. 8700 per person while for 35 people the charge is sh. 10,000 per person.

Calculate the fixed charge. (3 marks)

(*c*) If a person had paid the full amount and does not attend, the fixed charge is refunded. A group of people paid but ten per cent of them did not attend. After the refund the organiser remained with sh. 574,000.

Find the number of people initially in the group. (4 marks)

21 The curve of the equation $y = 2x + 3x^2$, has $x = -\frac{2}{3}$ and $x = 0$ and x-intercepts. The area bounded by the curve, x-axis $x = -\frac{2}{3}$ and $x = 2$ is shown by the sketch below.



Find:

(*a*) $\int (2x + 3x^2)\,dx$ (2 marks)

(*b*) the area bounded by the curve, x-axis, $x = -\frac{2}{3}$ and $x = 2$. (6 marks)

22 The line segment BC given below is one side of triangle ABC.

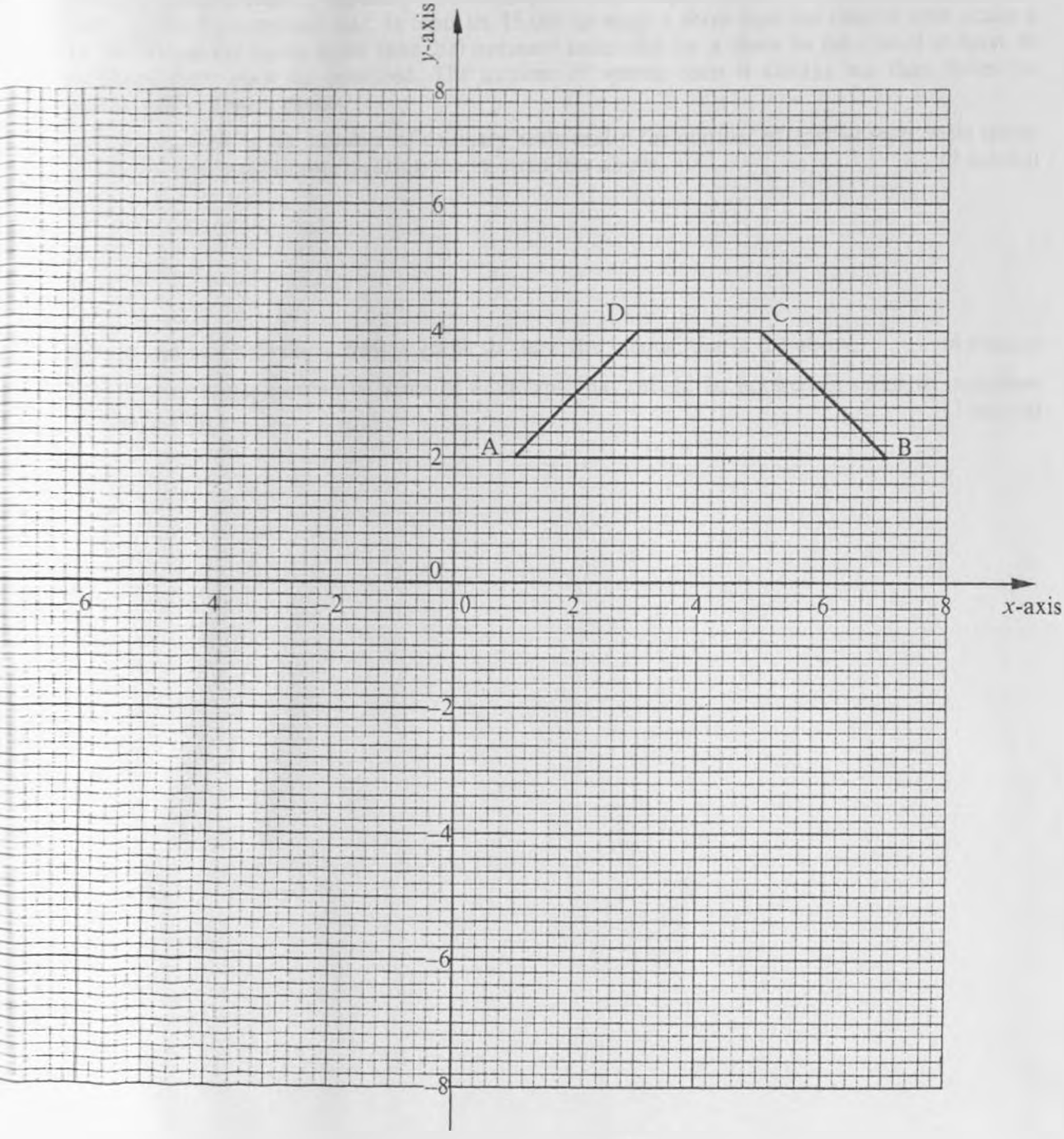
(*a*) Use a ruler and compasses to complete the construction of triangle ABC in which $\angle ABC = 45°$, AC = 5·6 cm and angle BAC is obtuse. (2 marks)

(*b*) Draw the locus of a point P such that P is equidistant from a point O and passes through the vertices of triangle ABC. (2 marks)

(*c*) Locate point D on the locus of P equidistant from lines BC and BO. Q lies in the region enclosed by lines BD. BO extended and the locus of P.

Shade the locus of Q. (4 marks)

3 The diagram on the grid provided below shows a trapezium ABCD.



On the same grid:

(*a*) (i) Draw the image A′B′C′D′ of ABCD under a rotation of 90° clockwise about the origin. (1 mark)

(ii) Draw the image A″B″C″D″ of A′B′C′D′ under a reflection in line $y = -x$. State the coordinates of A″B″C″D″. (3 marks)

(*b*) A‴B‴C‴D‴ is the image of A″B″C″D″ under the reflection in the line $x = 0$.

Draw the image A‴B‴C‴D‴ and state its coordinates. (2 marks)

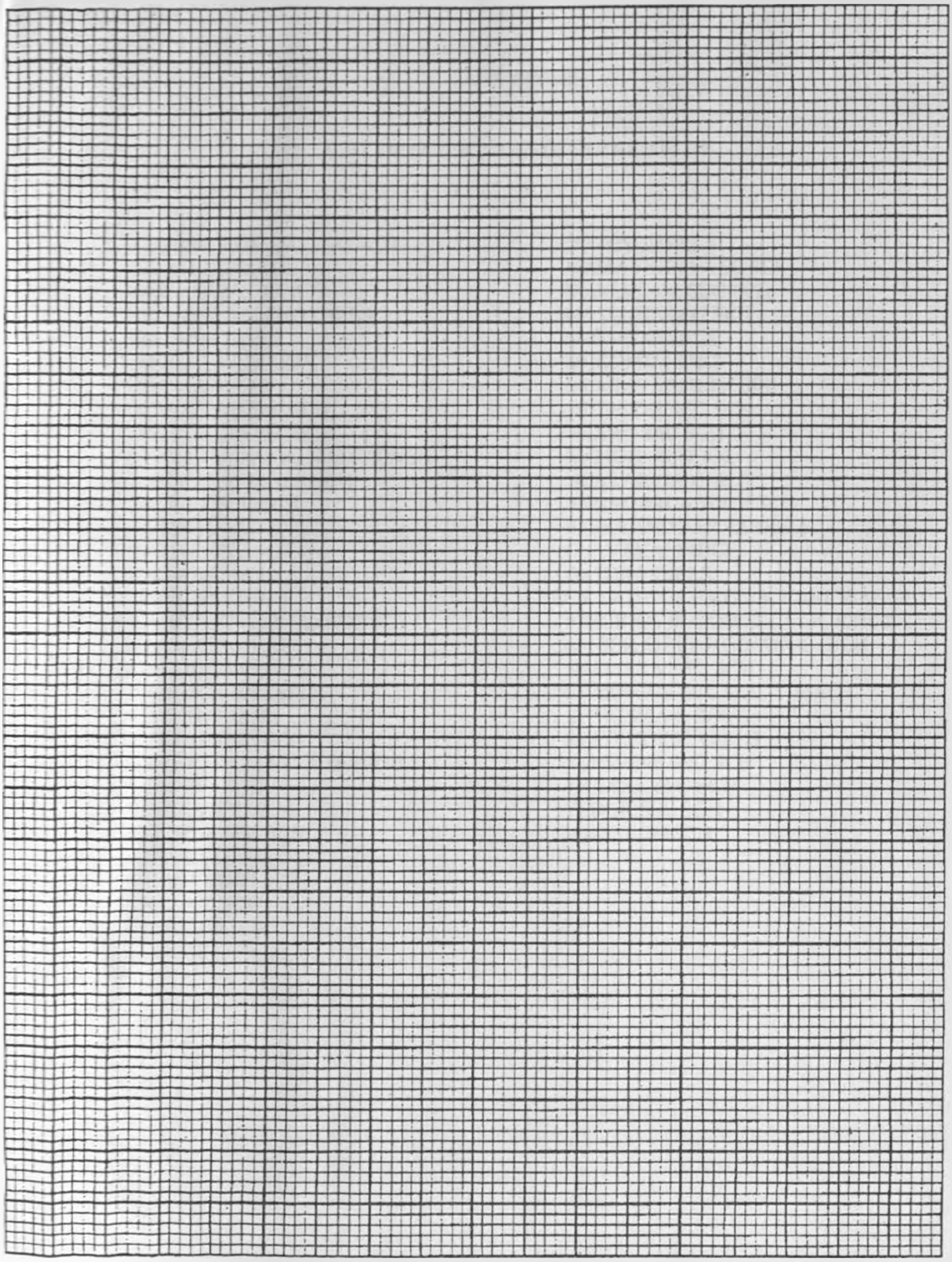
(*c*) Describe a single transformation that maps A‴B‴C‴D‴ onto ABCD. (2 marks)

24 A theatre has a seating capacity of 250 people. The charges are sh. 100 for an ordinary seat and sh. 160 for a special seat. It costs sh. 16,000 to stage a show and the theatre must make a profit. There are never more than 200 ordinary seats and for a show to take place at least 50 ordinary seats must be occupied. The number of special seats is always less than twice the number of ordinary seats.

(*a*) Taking x to be the number of ordinary seats and y the number of special seats write down all the inequalities representing the information above. (2 marks)

(*b*) On the grid provided, draw a graph to show the inequalities in (*a*) above. (4 marks)

(*c*) Determine the number of seats of each type that should be booked in order to maximise the profit. (2 marks)



APPENDIX F

LIST OF SCHOOLS USED IN THE STUDY

ALIDINA VISRAM HIGH SCH
ALLIANCE GIRLS
BARANI SEC SCH
BISHOP SULUMETI GIRLS
BONDENI GIRLS
BOOKER ACADEMY
CHINGA GIRLS
DEVOSHIRE SEC SCH
EBUSAKAMI SEC SCH
FRIENDS SCHOOL. KAMUSINGA
GAICHANJIRU SEC SCH
GALANA SEC SCH
HURUMA GIRLS
IGIKIRO SEC SCH
IHIGA SEC SCH
JAMHURI HIGH
KABETE APPROVED SEC SCH
KAKAMEGA HIGH
KAMAHUHA GIRLS
KAMANDURA GIRLS
KANGEMI HIGH
KARURI HIGH SCH
KENYATTA MWATATE HIGH
KIAMBU HIGH
KIHARA SEC SCH
KIWINDA SEC SCH
KUTUS SEC SCH
KWALE HIGH SCH
LARI SEC SCH
LUBINU BOYS
LUGULU GIRLS
MADZUU GIRLS
MAMA NGINA SEC SCH
MARIAKANI SEC SCH
MATENDE SEC SCH
MATUGA GIRLS
MUKUMU GIRLS
MUMIAS MUSLIM SEC
MUTHITHI SEC SCH
NAARO SEC SCH
NAIROBI SCHOOL
NGARARIGA GIRLS
NYANDARUA HIGH SCH
PARKLANDS ARYA GIRLS
CHAVAKALI HIGH
GATURA GIRLS
OUR LADY OF FATIMA. KARIOBANGI
PRECIOUS BLOOD SEC SCH. RIRUTA
SENIOR CHIEF KOINANGE HIGH
SHAMATA SEC SCH
ST MONICA SEC SCH. LUBAO
ST TERESA'S BOYS
STATEHOUSE GIRLS
SUNSHINE SEC SCH
THAARA SEC SCH
TUDOR SEC SCH
WAA HIGH SCH

APPENDIX G
MAP OF KENYA SHOWING PROVINCES

APPENDIX H
COPY OF RESEARCH PERMIT AUTHORISING THIS STUDY

PAGE 2

THIS IS TO CERTIFY THAT:

Mr./Mrs./Miss BONIFACE NGARUIYA NJOROGE

of (Address) NAIROBI UNIVERSITY P.O. BOX P.O. BOX 30197, NAIROBI

has been permitted to conduct research in

Location, ALL

District, ALL

Province,

on the topic A STUDY OF MATHEMATICS HOMEWORK IN KENYA

for a period ending 30TH SEPTEMBER, 2000

PAGE 3

Research permit No. OP/13/001/C8C 161

Date of issue 10TH SEPTEMBER, 1998

Fee received KSHS. 1000/=

Applicant's Signature

for J. E. EKIRAPA
Permanent Secretary,
Office of the President

RAW STUDY DATA.

The data obtained in this study was analysed using the SPSS statistical package. The data was organised and analysed in three different file, one each for students, teachers and schools. The output of such a file is voluminous and has thus been omitted.

Any enquiries on the study data may be addressed to the author at the following address:

Department of Educational Communication and Technology,

Faculty of Education

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NAIROBI