

The Availability, Adequacy and Improvisation and the Use of Instructional Resources for Teaching Mathematics in Secondary Schools in West Pokot District, Kenya

Koros C. Symon^{1*} Mubichakani M. Joseph²

1. PhD Student, school of Education, University of Eldoret, Po box 192, Kitale 30200, Kenya
2. PhD Student, school of Education, University of Eldoret, Po box 9537, Eldoret 30100, Kenya

*Email of second author: kosyche@yahoo.com

E-mail of corresponding author: joemukuyuni@gmail.com

Abstract

This study examined the factors that influence the use of instructional resources/materials in the teaching of mathematics in secondary schools. Among the instructional materials that were investigated in their use are: Textbooks and mathematical tables. The study focused on their use in terms of their availability, adequacy and improvisation. The research design that was used in the study is descriptive survey. The research instruments included questionnaire, interview schedules and document analysis. The sampling techniques that were used in this research are stratified, simple random and purposive sampling. The respondents comprised 24 mathematics teachers and 372 form two students. Four teachers were interviewed. Data analysis was done by use of descriptive statistics. The study revealed that the selected instructional materials are not adequate. The main recommendations are that school administrators, teachers, students and parents should be sensitized on the importance of provision of instructional materials adequately.

Keywords: Availability, Adequacy, Improvisation, Use and Instructional Resources (textbooks and mathematical tables).

INTRODUCTION

Brown, Lewis, Richard and Harclerod (1985) assert that, instructional materials and aids are an essential requirement for successful teaching. Many teachers find that seeking and finding resources that produce results when students use them is a distinct pleasure among the multitude of teaching details. Use of teaching and learning materials activates students and as they learn actively, the teacher can enjoy the evidence of their progress.

The benefits that accrue from effective use of instructional materials abound. Instructional materials when used well make the entire teaching and learning processes complete and functional. They facilitate the understanding of difficult concepts and principles. Ideally, they make it easier for learners to follow, understand, respond to and retain content of the lesson (Gamble 1984). At College and university, student teachers are required to learn how to make and use simple and cheap teaching aids. They are also trained to operate and use sophisticated media resources such as radios, tape recorders, overhead projectors and sometimes the computers.

Kilundo (2002) observes that, it is impossible to have meaningful teaching and learning in schools in the absence of these teaching materials. Lack of teaching materials can hinder any teaching programme from operating with desired efficiency. He argues that while both experience and available literature would support the view that materials are associated with high academic achievement, there is no need just to verify, but to study the efficacy of those materials in the wider context of school quality.

This study concentrated on the use textbooks and mathematical tables in the teaching mathematics. The consideration of the above instructional resources was necessitated by the fact that they are the most common and readily available in secondary schools. They are also recommended by the Kenya Institute of Education (KIE 2002) a branch of the Ministry of Education that assesses and recommends all the instructional resources to use in teaching in secondary schools.

Significance of the Study

This study can be helpful in that it can contribute to identifying if there are any problems and inadequacies of the present training of teachers of mathematics in colleges and universities. This is especially in the use of the readily available resources for teaching mathematics. It will also benefit mathematics teachers in identifying the shortcomings in their instructional methods. It is also hoped that the findings will be useful to the Quality Assurance Officers (QASOs) in the Ministry of Education who are responsible for curriculum development, interpretation and implementation.

The Kenya Institute of Education (KIE) which is mainly concerned with recommendation of important instructional resources to be used in schools will also benefit. This study is also geared towards identifying areas where teachers and students lack the skill in the use of readily available instructional materials and where necessary how improvisation can be helpful. It can go a long way in improving students' achievement in

mathematics.

REVIEW OF RELATED LITERATURE

Textbooks

Ornstein (1995) says that traditionally the textbook has been the most frequently used instructional material at all levels beyond the primary grades, and in some cases it is the only one used by the teacher.

Brown et al. (1985) on the other hand also says that a textbook is a versatile product. It provides convenient and random access to the message it contains; learners control the process by which they gain information they seek. Miheso (2004) further comes up with five patterns that characterize textbook utilization, they are;

- The traditional pattern is to use the textbook as a source of homework assignments, either for reading or various types of exercises.
- Related to the use of the textbook as a source of problem on their own; a pattern common in mathematics instruction.
- Textbooks may be used as the primary source of instruction, allowing their content and structure to determine the nature and arrangement of the course. Two or more textbooks may be used in conjunction with one another as the basis of instruction.
- A variation of this is the multi- text approach, where single text is replaced by a classroom collection of a variety of textbooks. Student functioning in this mode must make use of the classroom textbook collection, but are free to choose the particular text they find most useful.
- Lastly, textbooks can be used as supplementary materials with reading matter or exercises from them incorporated where appropriate to expand upon or elucidate materials presented via instructional means.

The contribution of good mathematics textbook

The mathematics textbook is a major factor in determining what mathematics topics are taught and how they are taught. Teachers consult the textbook than the syllabus. It dictates the scope, the sequence and pace of mathematics programme (Brown, et al. 1985).

The text should be selected on the basis of prior curriculum decisions. The following are some of the justifications for continued use of textbooks in mathematics instruction according to Brown, et al. (1985).

- It provides most of the content for a course. As such, it should contain appropriate mathematically correct topics presented in readable and orderly manner.
- It presents topics in a manner that builds understanding of concepts, structures, problem solving and computations. It is a tool to achieve objectives of the course.
- It provides exercises, experiences and directions for attaining mastery through practice, review, application and thought provoking questions.
- It provides means for individualized study, and thus is useful for assignments, make-up-work and remedial instruction.
- Mathematical tables, definitions, formulae theorems and proofs are available in textbook to make problem solving useful.
- It provides the basis for achievement testing. This is obtained from end of chapter, unit and topic tests.
- It provides for uniformity of the level of learners from one point to another.

Mathematical Tables

From the Wikipedia, the free encyclopedia, mathematical tables are lists of numbers showing the results of calculation with varying arguments to simplify and drastically speed up computation. Table of trigonometric functions were first known to be made by Hipparchus. Tables of common logarithms and antilogarithms were used to do rapid multiplications, divisions, and exponentiations including the extraction of the n th roots.

Table of special functions are still in use. For example, the use of tables of values of the cumulative distribution function of the normal distribution remains common place today, especially in schools and colleges. Also from the Wikipedia the free encyclopedia, a table is both a mode of visual communication and a means of arranging data. The use of tables is pervasive throughout all communication, research and data analysis.

The tables appear in print media, handwritten notes, computer software, architectural ornamentation, traffic signs and many other places. The precise conventions and terminology for describing tables varies depending on the context. Moreover, tables differ significantly in variety, structure, flexibility, notation, representation and use.

This study looked at the mathematical tables which according to definition by Too (1996) is a multipurpose handbook which provide computer worked out logarithms and antilogarithms of numbers, trigonometric values, reciprocals of numbers, squares and square roots of numbers, radians, mathematical formula etcetera.

The handbook provides tables of the areas mentioned above and assist the learner to simplify and speed up calculations.

In most cases, the handbook is a requirement for each and every high school student.

This may be attributed to the fact that mathematics is a compulsory subject (Ministry of Education Syllabus,

1992).

The oldest known mathematical table was found in the ancient Sumerian city of Shuruppag in Southern Iraq. Since then, tables have been important feature of mathematical activity and are important precursors to modern computing and information processing.

RESEARCH DESIGN AND METHODOLOGY

The research design used in this study is descriptive survey. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2002). Four teachers were interviewed. To collect information from other teachers, a teachers' questionnaire was used and 24 teachers filled the questionnaire. Also, 372 students in form two classes filled the students' questionnaire.

Area of the Study

The study was carried out in West Pokot District. It is one of the districts in Rift Valley province covering an area of approximately 9100 sq. km. The district lies in the North Western part of Kenya bordered by Uganda to the West, Turkana District to the North, Marakwet District to the East and Trans-Nzoia to the South. There are 27 secondary schools, five of which are provincial, twenty are district and two are private.

Population

The study focused on mathematics teachers and forms two students in secondary schools in West Pokot District. According to the records obtained from DEOs office, there were 63 mathematics teachers and 1910 form two students in the district.

Sampling Procedure

Stratified random sampling was used in this study. For the purpose of getting a representative sample, schools were categorized into three groups, namely, provincial, district and private schools. They were labeled A, B and C respectively. The provincial schools were further grouped into boys' and girls' school of which each was represented. To obtain a boys' or a girls' school, purposive sampling was used. Two boys' and two girls' schools were purposely picked to represent population of provincial schools. Purposive sampling was used because of convenience but it was deemed that the picked sample represented the population.

The district schools were categorized into three, namely; boys' girls' and mixed schools. Two boys', two mixed and one girl's schools were purposely picked to be the sample to represent district schools. Only one private school was used since it is the only one which had reached form two, the other had a form one class only. The categories were meant to ensure that each and every type of school was represented.

Proportionate random sampling and simple random sampling were used to select the form two students whom the questionnaire was administered to. Fifty questionnaires were administered in each provincial school because they are three streamed. This is because in a classroom there are between 40 and 50 students and therefore a provincial school with three streams will have a maximum of 150 students. In that case, the 50 form two students who were randomly selected across the streams to fill the questionnaire. This number formed at least the recommended 30% of the population which is an adequate sample size that was required. The same criterion was used in district schools and 30 questionnaires were administered in two streamed and 20 were administered in one streamed school. The same criteria also applied to the private school. The students who filled the questionnaire were picked by simple random sampling in form two classes.

Research Instruments

The collection of data was done by use of questionnaire, interviews, and document analysis.

Questionnaires

The researcher developed a questionnaire based on the objectives and research questions. The questionnaire comprised of structured and unstructured questions.

Two types of questionnaires were constructed, namely, the Mathematics Teachers Questionnaire (MTQ) and Form Two Students Questionnaire (FTSQ).

The MTQ was divided into TWO sections. Section A and B which comprised of:

- A- Schools' and Teachers' background information
- B- Teaching and learning resources for mathematics. Questions for each selected instructional material were separately developed. The questionnaire contained items that covered each of the selected instructional material based on adequacy and improvisation, quality and relevance, teachers' and students' attitudes towards them and their maintenance and storage.

The FTSQ comprised of structured and unstructured questions concerning the selected instructional materials. These questions were meant to capture the students' awareness and ability to use instructional resources.

Interviews

Interviews were conducted informally with structured questions. The Heads of Departments (HODS) for

Mathematics were interviewed and in case of their absence one mathematics teacher was interviewed. The responses were used to analyse data qualitatively. This involved, summarizing and explaining key issues recorded by the researcher. The interviews took forty to fifty minutes for every teacher.

Document Analysis

The documents that were analyzed included; teachers' and students' records, inventories, book issue lists, schemes of work lesson plans, and records of work covered. Teachers' and students' records showed the number of mathematics teachers and students enrolled in form two in the district. Inventories showed items bought by school administration but of concern were the instructional resources. Book issue lists showed how books were shared among the students. Schemes of work, lesson plan and records of work covered gave information on the instructional resources teachers use in teaching mathematics.

Data Collection

Simple random sampling was used to select students whom the questionnaire was administered to across the form two classrooms. Equal numbers of questionnaire were given to each stream if the school was two or three streamed.

Interviews were conducted with the HODs and teachers present and willing. The interviews were semi-structured because they involved informal interaction between the researcher and the teachers in their respective offices. In total, four teachers were interviewed, one from provincial school, two from two different district schools and one from a private school.

Data Analysis and Presentation

In the research, descriptive (quantitative) statistics, and qualitative techniques were used to analyze the data. In this study the quantitative statistics used were mean, frequencies and percentages. This study also used qualitative techniques to analyze data collected from content analysis and interview schedules. Presentation of data was done by use of graphical techniques i.e. use of frequency tables.

FINDINGS

Demographic profile of the respondents

Among the 372 form two students who responded to the questionnaire, there were 196 from provincial schools, 156 from district schools and 20 from the private school.

Table 1 shows the number of teachers who responded to the MTQ in relation to the type of schools they taught.

Table 1: Demographic profiles of Teacher Respondents

Type of school	Frequency	Percentage
Provincial	15	62.5
District	8	33.3
Private	1	4.2
Total	24	100.0

The total number of teachers who filled the questionnaire was 24, of which 62.5% came from provincial schools while 33.3% and 4.2% came from district and private schools respectively. This implies that majority of the respondents taught in provincial schools which had higher population compared to the district and private schools.

Types of Textbooks Used in Teaching Mathematics.

Teachers were asked to give the types of textbooks they use in teaching mathematics form two classes. Their responses are summarized in Table 2

Table 2: Teachers' Responses on Types of Textbooks Used For Teaching Mathematics in Form 2

Type of textbook	Frequency	Percent
KLB	21	87.5
Advancing in Mathematics	3	12.5
Total	24	100.0

KEY: KLB- Secondary Mathematics students Book 2 Schools by Kenya Literature Bureau

Table 2 shows the main textbooks that secondary school mathematics teachers use for instructional purposes. The Secondary Mathematics Form 2 Book (KLB) was the most preferred and 87.5% of teachers listed as a main textbook, 12.5% used Advancing in Mathematics for Secondary schools. The Secondary Mathematics Students Book 2 (KLB) is used by many teachers and students probably because it is the textbook approved by the Ministry of Education through the Kenya Institute of Education.

On the other hand, students were also asked to name the textbook they and their teachers always used. Their responses are depicted in Table 3.

Table 3: Students' Responses on the Textbook Mostly Used For Teaching Mathematics

Responses	Frequency	Percent
KLB	333	89.5
Advancing in Mathematics	25	6.7
No response	14	3.8
Total	372	100.0

KEY:

KLB: Mathematics for secondary schools by KLB.

Table 3 also shows that 89.5% of students in the sample used Mathematics for Secondary School (KLB). Only 6.7% used Advancing in Mathematics Form 2 textbook. This correlates highly with the teachers' responses in table 2 though 3.8% of students never responded.

Adequacy of Textbooks

To determine if the textbooks used by students were enough, students were required to state the number of students who shared a copy. Their reactions are noted in Table 4.

Table 4: Student - Textbooks Ratio

Number of students who share a copy of textbook	Numbers of students	Percent
5 student per copy	144	38.7
2 Students per copy	111	29.9
3 students per copy	58	15.6
4 students per copy	54	14.5
1 students per copy	5	1.3
Total	372	100

Table 4 shows how students share the textbooks they use in classroom. Among the 372 students 38.7% indicated that 5 students shared one copy, 29.9% noted that they shared two students a copy, 15.6% of students noted that they shared three students a copy, 14.5% of students indicated that they shared four students a copy while only 1.3% indicated that each student had his or her own copy.

Availability and Use of Mathematical Tables

Students and teachers were asked to indicate if they possessed a mathematical table.

Their responses are shown in tables 5 and 6 respectively.

Table 5: Students' Possession of Mathematical Tables

Possessing a mathematical table	Number of students	Percent
Yes	306	82.2
No	62	16.7
No response	4	1.1
Total	372	100.0

For mathematical table, 82.2% of students who responded to the questionnaire had their own mathematics tables, 16.7% indicated that they did not have while 1.1% never responded.

Table 6: Teachers' Possession of Mathematical Tables

Possession of mathematical tables	Number of teachers	Percent
Having own	22	91.7
Borrowing from colleagues	2	8.3
Borrow from students	0	0
Total	24	100.0

Majority of the teachers, that is, 91.7% possess mathematical tables and 8.3% borrow from colleagues. The fact that most students and teachers possess mathematical tables shows that they have enough for use.

Teachers were asked to state how they assisted students who had problems in using mathematical tables. The responses are shown in table 7.

Table 7: Ways of Guiding Students who do not know How to Use Mathematical Tables

Ways of helping students	Frequency	Percent
Remedial lessons and illustrations		
Individual guidance	12	50.0
No response	5	20.9
Discussion	3	12.5
More assignments given	2	8.3
	2	8.3
Total	24	100.0

Table 7 shows that 50.0% of teachers assist students through remedial lessons and illustrations, 20.9% by individual guidance, 8.3% through discussion, 8.3% by giving more assignments and 12.5% never responded. All the approaches above can assist students to gain skills of reading mathematical tables. Those who did not respond could imply that they do not assist their students.

CONCLUSIONS

The study found out that the textbooks used in teaching mathematics are mainly two types, namely; Secondary Mathematics Form 2 Book by Kenya Literature Bureau and Advancing in Mathematics by Kinyua, Maina and Wandera. This information is inferred from Table 2 and 3. When the researcher interviewed Mr. Shamo Charles Rotich a mathematics teacher at Ortum Secondary School on 4th May 2008 on why he used Mathematics for Secondary Schools by KLB, Shamo noted that the book was simple in language and follows the syllabus and therefore it is very convenient to use it. This argument can also be given by other teachers. For the students, the reason could be, because their teacher selected it.

The student- textbook ratio is quite high. From Table 4 over two thirds (68.8%) of students indicated that more than three students shared a single textbook. This implies that the textbooks used for teaching mathematics are not enough. In most cases, any ratio of more than two students per copy of a textbook is inappropriate because some students may not access it. This makes the teaching and learning processes difficult.

Eshiwani (1983) noted that owning a personal mathematics textbook has been found to have a positive relationship with performance. The inadequate number of textbooks affects the performance of students negatively. In that note, students should be encouraged to buy own copies if they can afford so as to supplement those that schools buy. Textbooks cannot be improvised but the inadequacy can be negated by teachers using group work teaching and writing assignments on the chalkboard. On interviewing Mr. Chemweno Zephania, the Head of Mathematics Department at Tartar girls' Secondary School on 5th May 2008, he noted that group work encourages students to learn mathematics but group work is also good when textbooks are few.

Mathematical table is an important component of mathematics instruction at all levels in high school. Over 80% of students noted that they possessed a mathematical table. This is shown in Table 5. This implies that mathematical tables are not enough because it is a requirement for each and every student. Mr. Shamo posits

“ not all students have mathematical tables, when examinations are on, they borrow. They are also advised to have them when required and normally they borrow from students in other classes who may not be requiring them at that period. They have been advised to have them but some do not have”

The fact that each and every student does not possess a mathematical table means that they have difficulty in learning some mathematical concepts

Recommendations

The research findings have been illustrated from the discussions of findings and the conclusions. The following are some of the recommendations made from the findings.

Textbooks form the basis of any teaching and learning of mathematics in secondary schools. The shortage of textbooks is detrimental to instructional process and teaching and learning objectives can rarely be achieved. The textbooks must be adequate for any meaningful learning to take place.

If possible a variety of textbooks recommended by the Ministry of Education may provide the best recipe for students to learn mathematics. Teachers should not take Secondary Mathematics Form 2 Book by KLB as the sole textbook. There are other textbooks approved by the Ministry of Education and they can also be used. Some of the textbooks are, Advancing Mathematics for Secondary Schools, Discovering Mathematics, Comprehensive Mathematics, General Mathematics and many others should be included in teaching mathematics and not only used as reference materials or sources of assignments. This enables the teachers and students to experience a variety of methods of solving mathematical problems and different ways of applicability of mathematics in real life situations. There are no textbooks that can have exactly the same approach in solving mathematical problems.

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Koros C. Symon was born in Bomet County in 1972. He joined Sikhendu Primary School in 1978 and later on Kapenguria Primary School where he did his Kenya Certificate of Primary Education (KCPE). He joined Kericho High School and later on Lukhuna Secondary where he did his Kenya Certificate of Secondary Education (KCSE) in 1990. In 1992, he joined Kenyatta University and graduated in 1996 with a B.ED (Arts) degree. He taught Mathematics and Geography in high school until 2006 when he enrolled for Master of Philosophy in Educational Communication and Technology(Mathematics Education). Currently he is a part time lecturer at Mt. Kenya University- Kitale campus and a Doctorate student of Educational Communication and Technology (Mathematics Education) at University of Eldoret (UOE). Koros has published a book with Lambert Academic Publishers and with a journal of International Institute for Science Technology and Education. Vol. 2, 2012.

Mubichakani M. Joseph was born in 1983 in Bungoma County. He joined Kamusinde F.Y.M School and did his Kenya Certificate of Primary Education in 1997. He joined Kimilili Boys' High School in 1998 where he did his Kenya Certificate of Secondary Education in 2001. He was in Moi University for his undergraduate from 2003 to 2007 and graduated with B. ED (Arts) degree. Currently, he is a PhD student in Mathematics Education at University of Eldoret. He holds a degree of Master of Philosophy in Educational Communication and Technology (Mathematics Education) from Moi University. He is also computer literate having trained at Millennium Research Consultant and practicing it in his lecturing and research. He is a part time lecturer at University of Eldoret and Moi University. Mubichakani has an experience of teaching mathematics courses both at degree and diploma level at Mt Kenya University for more than two years. He has also taught Mathematics Education course at University of Eldoret and Moi University. Mubichakani has published a book with Lambert Academic Publishing.

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