ADEQUACY AND THE EXTEND TO WHICH TEACHING AND LEARNING RESOURCES FOR MATHEMATICS ARE AVAILABLE AND USED FOR ACHIEVEMENT IN THE SUBJECT IN SECONDARY SCHOOL IN KENYA

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Abstract

Achievement in mathematics at Kenya secondary school has been poor over the years. This prompted the study to determine the adequacy of teaching and learning resources in secondary schools as a contributing factor to achievement in mathematics. Ex post facto research design was used, and an observation schedule, mathematics teachers' and students' questionnaires were used to collect the needed data. A total of 661 form three students and 71 mathematics teachers participated in the study. The findings indicate that secondary schools are poorly equipped with the teaching and learning resources for mathematics; which is serious since mathematics is an abstract subject which requires these materials to facilitate abstraction of concepts by the learners. Hence, drastic action is required in provision of mathematics teaching and learning materials in secondary schools.

Key Terms: Abstraction, Achievement and Resources

Introduction

It is necessary for a person to have some knowledge of mathematics in order to be a useful and effective member of society. Mathematics is also necessary in the study of most science subjects including Geography. Plato during his time, he recommended the study of mathematics as a prerequisite for the study of philosophy (Marshall, 1995). Therefore, mathematics is regarded as an essential component of the school curriculum. Achievement in mathematics has been poor over the years. Butler-por (1987) found that some weak students were pretty bright but for different reasons had lost confidence in their ability to cope with their mathematics work, but when each child was helped to understand the specific problem in arithmetic that had been holding it back, they made remarkable progress. Some of the mathematics teaching and learning resources in secondary schools include; chalk boards, mathematics textbooks, three dimensional figures and charts. Concept formation in secondary schools is still linked to concrete representation, and on the mental activity that takes place as the child experiences and interacts with his or her environment (Cornelius, 1982).

For concepts to develop effectively, pupils need to perform their own physical actions until they are able to reason abstractly. Thus children must have the real and relevant variety of practical experiences if they are to internalize a concept. Thus concepts are constructed from a series of experiences. Piaget's stages of intellectual development are useful guides to the teaching in which he emphasizes concrete operational materials that facilitate learners internalize concepts presented to them. Understanding is important and desirable since it generally promotes retention of the concept. Dreyfus (1990) says students construct knowledge dialectically by progressing through a series of concept images whose evolution is conditional on overcoming cognitive obstacles. Hence the need to determine the adequacy of teaching and learning resources for mathematics, since this would affect achievement in the subject.

Methodology

The following was considered under methodology;

i) Objectives of the Study

Objectives of the study were to determine; the availability and adequacy of mathematics teaching and learning resource in secondary schools in Kenya, their quality, the extent to which these teaching and learning resources are used or made available to students by mathematics teachers during mathematics lessons, and whether there is a relationship between students' achievement in mathematics and availability of teaching and learning resources.

ii) Population and Sample Size

According to the Ministry of Planning and National Development (2002), the form threes population was 211,394 students. A minimum normal sample from this population is 384 students (Kathuri & Pals, 1993). Hence the accessible population is sufficient for generalising the results; 661 form three students (352 boys and 309 girls), and 71 mathematics teachers, where 39 were males and 32 females. The provincial Directors of Education and the District Education Officers assisted in the identification of the schools involved.

iii) Instrumentation

Three instruments were use to provide the needed data; the mathematics classroom observation schedule provided information on what goes on in class in relations to availability and use of mathematics teaching and learning resources, two questionnaires provided general information from teachers and students on availability, sufficiency, use and on quality of mathematics teaching and learning resources in secondary schools.

iv) Research Design

The ex post facto research design was employed in this study, the independent variable is the teaching and learning resources, the dependent variable is achievement in mathematics. The intervening variables are learners' intelligence and their background, peer influence and their teacher's training, experience and competence.

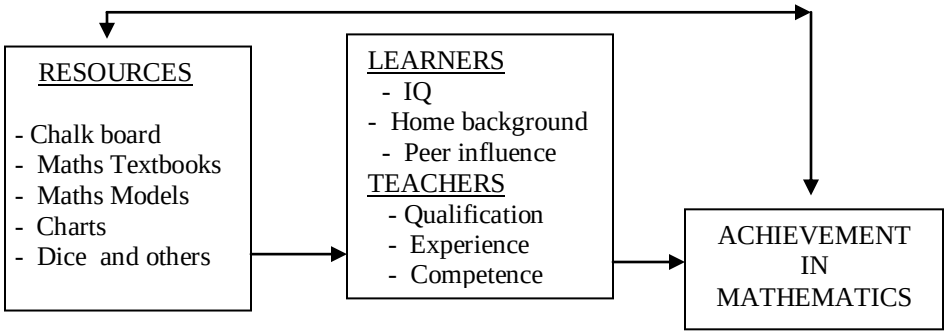

Figure 1: Relationship between Resources and Achievement in Mathematics

Results and Discussion

Descriptive statistics were used to analyze the data and the obtained results are presented in form of tables.

i) Average Number of Students per Class

The expected number of students per class is 40, however data obtained indicate that 81.7% of the schools have more 40 students per class. This would stretch use of teaching and learning resources. Also, a crowded class does not provide a good atmosphere for use of teaching and learning materials during mathematics lessons. According to Holliday (1994), in small classes there is more teacher/student interaction and more effective use of teaching and learning resources.

ii) Teachers Qualifications

Secondary school mathematics teachers are expected to be professionals by training. Data obtained shows that 98.52% of secondary school mathematics teachers are professional teachers; therefore their output is expected to be high. Mastery of the subject is an absolute necessity for effective teaching, the teacher must posses a basic qualification in the subject and the level of qualification should be much higher than that of the information he/she is expected to impact (Njeru & Orodho, 2003). Hence, in this case teachers are expected to use effectively mathematics teaching and learning resources as professional teachers.

iii) Chalk Board

Modern technology has not yet penetrated in secondary schools in Kenya where computers and power point are used. Chalk board is still the most powerful tool used in the teaching of mathematics. Mathematics is taught by solving problems on the chalk board. Therefore, presence of a chalk board in a class room is mandatory. Also mathematical symbols and structures when red aloud sound like normal English words but when written they appear completely different from normal English, hence learners must see them clearly when written on the board. Data obtained indicate that all classes had chalk boards; however 70% of them are poorly maintained with faded paint and others are badly worn out.

This is serious since learners cannot be able to follow the lesson due to poor chalk boards. The quality of chalk used in teaching was poor in all schools that participated in the study, hence negatively affecting achievement in mathematics.

iv) Chalkboard Geometrical Instruments

Chalkboard geometrical instruments facilitate proper and accurate drawing of figures on the board. Data obtained on teachers indicates that 62.7% of schools have blackboard geometric instruments, but 27.0% of them rarely use them or think of them as important tools of teaching mathematics. Therefore achievement in mathematics could be improved if teachers are made to use geometrical instruments when teaching since most of the schools has them. The instruments should also be provided in schools which lack them.

v) Mathematics Textbooks

Mathematics textbooks could be the second most powerful tool of teaching and learning mathematics to the chalkboard. Currently there are no recommended school mathematics textbooks, schools are free to identify and use any or several mathematics textbook they feel is/are adequate for them. The results obtained indicate that 9.9% of schools have enough form one mathematics textbooks, 11.3% have enough form two textbooks, and 15.5% of schools have enough form three mathematics textbooks. The small percentages indicated for schools with enough mathematics textbooks are a pointer to the critical shortage of mathematics text books in schools.

The mathematics syllabus provides only a list of topics to be covered in secondary school curriculum. It is mathematics textbooks that adds flesh to the syllabus, determine sequence of teaching and provide exercises for masterly of concepts. Thus, schools without sufficient mathematics textbooks are disadvantaged. Mathematics textbooks provide most of the indicated content in the syllabus. They form the basis for classroom instruction; they indicate the scope and sequence of the content to be taught. Topics are built in a manner that builds understanding of concepts, structure, problem solving and computation. They also provide the exercises through which learners can attain mastery of concepts (Kosgei, 2004).

Most teachers use textbooks when teaching, they provide many supplementary materials such as problems to solve, extra practice and for assessment. According to Reys, Lindquist, Lambdin, Smith and Suydam (2001) there are many different types of textbooks, some provide a great amount of drill and practice but others offer little help in developing the understanding and using mathematics. Malloy and Jones (1998) say that many textbooks have a range of problems but some may not provide the challenges students may need.

The results obtained indicate that 52.1% of secondary school mathematics teachers have their own mathematics textbooks while 47.9% do not have. These shows about half of the mathematics teachers depend on school mathematics textbooks and thus both teachers and students are disadvantage in schools without enough books. Also, 70.4% of secondary school teachers prefer using the school mathematics textbooks while 29.6% prefer using their own mathematics textbooks.

According to the Ministry of Higher Education, Science and Technology (2010), mathematical concepts have close logical relationship between them, which make teaching and learning crucial. Therefore it is necessary for a school to have sufficient mathematics textbooks for teachers and students to be able to refer to both previous and current concept being taught. The curriculum and examinations are centrally prepared but have not been responsive to the availability or variations in the teaching materials (Ndirangu, Kathuri & Mungai, 2003). Also, Otunga (2000) found that resource preparation for curriculum implementation is not adequately addressed.

vi) Three Dimension Models

Information obtained indicate that 52.4% of schools have few or none of the three dimensional models for teaching mathematics. Three dimension models are used a lot in teaching and learning of mathematical concepts, mainly in geometry. Such models include; cuboids, cylinders, cones, pyramids, frusta, earth globe among others. Concepts like determining angle between two planes cannot be comprehended by learners without a teaching/learning aid. Therefore schools without such materials or teachers who ignore their use disadvantage their learners a great deal resulting to poor achievement in mathematics. Some of the mathematical models for teaching the subject are shown in Figure 2.

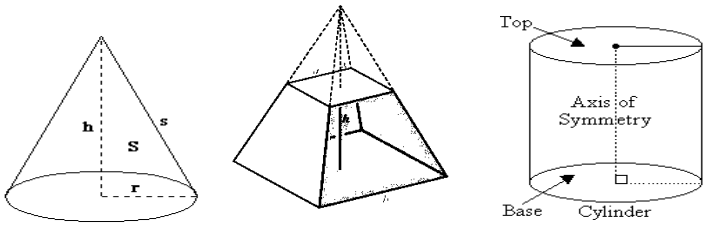

Figure 2: Three Dimension Mathematical Models

Bulimo, Odebero and Musasia (2010) indicated that availability of adequate learning resources would lead to high quality education in schools hence improvement in performance of national examinations.

Results on Table 1 indicate that 20.27% of the learners believe that teaching/learning aids are well used in schools, 48.11% indicated that they are fairly used while 31.62 indicated that they are under utilized. This shows that a lot of improvement on use of teaching and learning aids is required if achievement in mathematics is to be realized.

Table 1: Effective Use of Teaching/Learning Aids in Math's Lessons

	N	Percedantage
Well used	134	20.27
Fairly used	318	48.11
Under utilized	209	31.62
Total	661	100.00

Nwanekezi (2006) indicated that many teachers view using of teaching and learning materials as time consuming besides being expensive.

Data on Table 2 shows that the quality of mathematics teaching/learning aids in secondary schools are poor (51.89%). Poor quality of such materials makes it difficult for the learners to see the indented relationship resulting to poor achievement in the subject. Quality approach should be the guiding principle to address the issue of good quality teaching aids (Nwanekezi, 2006).

Table 2: Quality of Mathematics Teaching/ Learning Aids Used in Lessons_

Quality	N	Percentage
High	87	13.16
Average	231	34.95
Poor	343	51.89
Total	661	100.00

Information on Table 3 shows that 72.01% of students acknowledge that mathematics teaching and learning aids contribute to achievement in the subject. While 77.46% indicated that they make mathematics interesting, 65.96% indicated that they help in the displaying of the mathematics structures involved, and 48.26% believe that teaching and learning aids contribute to stimulus variation where more senses are involved. But on concrete representation of reality 34.95% indicate that they highly contribute, 44.33% indicated their contribution is average, while 20.73% indicated that there contribution is low; this may be due to their poor quality.

Table 3: Contribution of Teaching/Learning Aid to Learning Mathematics

CONTRIBUTION	HIGH		AVERAGE		LOW	
TO MATHEMATICS	N	%	N	%	N	%
Achievement	476	72.01	183	27.69	2	0.30
Interesting	512	77.46	141	21.33	8	1.21
Structures easily demonstrated	436	65.96	179	27.08	46	6.96
Stimulus variation	319	48.26	189	28.59	153	23.15
Concrete representation of reality	231	34.95	293	44.33	137	20.73

According to Wanjala, Khaemba and Sindabi (2010) the moves to competency and performance-based curricular are well supported and encourage by emerging instructional technologies and aids, such curricular tend to require access to a variety of information sources like teaching and learning aids. This would enable learners acquire the expected experiences.

Conclusion

Teaching and learning aids contribute to achievement in mathematics. However, there are insufficient mathematics text books in secondary schools. Schools have poor chalk boards which affects teaching and learning of mathematics, since the subject involves a lot of calculations, which has to be on the chalk board. Three dimension models or aids for teaching and learning mathematics are lacking, those that are available are of poor quality, and also teachers do not use them effectively well. The chalk board is in two dimension and drawing a three dimension on it may distort learners thinking; for example angles that are 90^0 of cuboids appear different on the chalk board.

Recommendations

Mathematics is a major subject in secondary schools and it is useful in producing members of the society who are numerate and logical in thought, the subject is also useful in learning other subjects, hence teaching and learning of the subject has to be improved by providing good chalk boards, enough and in variety mathematics textbooks. It is mandatory that three dimension models be provided to improvement achievement in mathematics. Teachers should be made to use teaching and learning aids whenever a mathematics topic requires so.

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