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STRATEGIES USED IN TEACHING MATHEMATICS: AN IMPLICATION OF GRADE THREE PUPILS' ACQUISITION OF EARLY MATHEMATICS COMPETENCIES

Joseph Kipkorir Rono,
Teresa Mwoma,
Nyakwara Begi[i]
Department of Early Childhood
and Special Needs Education,
Kenyatta University,
Kenya

Abstract:
Mathematics has been recognized globally as one of the important subjects as it is applicable in our everyday activities. It has been argued that mathematics is very important in life as it can be personally satisfying and empowering. Accordingly, it has been noted that the basics of life today are majorly mathematical and technological, hence when learners acquire the competency and adequacy, they significantly enhance their opportunities and options for shaping their future. It is therefore prudent that children attain mathematics competencies in their early years of education. Studies have shown that acquisition and retention of mathematics concepts and skills among children is low at various levels of their competencies. This necessitated a study which was conducted in Kipkelion sub-county in Kericho County with a target population of 4,140 spread in 81 public and 23 private primary schools. The purpose of the study was to find out the relationship between teachers' use of teaching strategies to enhance teaching of mathematics and grade three pupils' acquisition of early mathematics competencies. The study was guided by Social Development Theory by Lev Vgyotsky. The study adopted a correlation research design and mixed research method approach. Stratified random and simple random sampling techniques were used to select the sample for the study. Data was collected using questionnaires, observation schedules and pupils' mathematics competency checklists. The data was analyzed quantitatively and qualitatively using tables and texts. Results revealed that there was a significant relationship between use of teaching strategies and pupils' acquisition of early mathematics competencies.

Keywords: teaching strategies, mathematics competencies, numeracy skills, mathematics teaching

[i] Correspondence: email jkrono@kabianga.ac.ke, mwoma.teresa@ku.ac.ke, begi.nyakwara@ku.ac.ke

1. Introduction

Mathematics has been recognized globally as one of the important subjects as it is applicable in our everyday activities. It is therefore prudent that children attain mathematics competencies in their early years of education. Studies have shown that acquisition and retention of mathematics concepts and skills among children is low at various levels of their competencies. The National Council of Teachers of Mathematics (2003) argued that mathematics is very important in life as it can be personally satisfying and empowering. Accordingly, it noted that the basics of life today are majorly mathematical and technological, hence when learners acquire the competency and adequacy, they significantly enhance their opportunities and options for shaping their future. Mathematical thinking as well as problem solving is vital not only in the work place but in general life. Gates (2003) in his journal on issues of mathematics teaching, pointed out that mathematics enhance pupils' spiritual, moral, social and cultural development. Schleicher (2013) noted that we all need mathematics, not only for the purposes of schooling, but we also need it for our everyday life, work and opportunities. He further argued that mathematics competency such as good numeracy should be adopted as the best strategy against unemployment, low wages and poor health. Mondoh (2005) in his findings on a study carried out on methods of teaching mathematics: a handbook for teachers and students, observed that mathematics competency provides learners with a means of communication that is powerful, concise and unambiguous.

In any curriculum, mathematics is an important subject especially in primary and secondary school levels. Organization for Economic Co-operation and Development ([OECD], 2005) stated that mathematics is important in understanding science subjects. According to Salau (2000) there exist a connection between various science subjects and mathematics. This is to say that there is a relationship between learners' general outcome and their mathematical abilities. In mathematics curriculum, topics such as geometry require a learner to recognize, identify and make shapes and patterns which enhance skills which are important to careers such as architecture and engineering.

Allan (2011) defined competence as distinct ability to perform activities. Competency in mathematics is characterized by both content which learners acquire as well as the process which involve doing and understanding mathematics (Graf, 2009). Early mathematics competency is therefore about how young learners encounter challenges in mathematics and the manner in which they solve the challenges (International Competitions and Assessment for Schools Statement ([ICAS], 2013). According to Zhou, Peverly and Lin (2005) early mathematics competencies involve number operations, identification of geometric shapes, problem solving as well as logical reasoning. In addition, Kenya Institute of Curriculum Development ([KICD], 2017) pointed out early mathematics competencies that learners in grade three should acquire which include an understanding of number concepts, whole numbers, fractions and the four basic operations. They should also carry out measurement on length, mass, capacity, read time and identify money which were the focus of this study. Mathematical

competency means that a learner should think mathematically, understand mathematical proof, communicate in mathematical language and apply appropriate aids. In essence mathematical competency basically requires learners to have the skills to enable the application of mathematical principles and processes in everyday contexts both at home and work and to follow and assess chains of arguments.

Early mathematics competency is the ability of learners in early level of education to understand, operate and think mathematically. It is about the young learners possessing the right mathematical knowledge and using it accordingly (Sarama and Clement, 2009). Early mathematical competence can therefore be defined as having the capability to develop and use mathematical thinking by young learners to solve the everyday challenges that arise from various situations. To achieve this, learners need to have a mathematical reasoning to understand mathematical proof and communicate the same in mathematical language and to use appropriate aids if need be.

2. Literature Review

This section has literature review related to teaching strategies and theoretical framework.

2.1 Teaching Strategies

Teaching strategies are basically teaching approaches used by teachers in a classroom setup that address the needs of learners with a variety of backgrounds, learning styles and abilities for the acquisition of skills and knowledge. It can therefore, be said that teaching strategies are ways that teachers would use to tackle the curriculum, how they choose to relay knowledge to learners and finally the approaches that instructors rely upon in the dispensation and interaction with learners (Clarke, 2001; Alexander, 2000). Bautista, Cañadas, Brizuela and Schliemann (2015) also argued that the loving and understanding of mathematics depends on the choice and the use of appropriate approaches.

Teaching strategies provide a variety of practical approaches to aid in fostering the development of mathematics competency among learners. In every classroom across the world, teachers get exposed to learners from all walks of life and with very different ways of acquiring knowledge. Due to these factors, it is upon the teacher to develop effective and appropriate techniques of teaching that will ensure that various types of learners get the best learning experiences that make them competent during and after school. Through the provision of meaningful experiences in the classroom, teachers can and will facilitate learners so that they can investigate meaningful problems and subsequently solve them in more effective ways. This according to Indiana Professional Standards Board (2002) entails incorporating strategies that not only create meaningful experiences but also remove mathematics misconception in the minds of learners. The use of appropriate strategies leads to meaningful experiences which in turn result in the learners acquiring understanding of various mathematical concepts.

According to Moore (2012) in a study on alternative strategies for teaching mathematics undertaken in America, negative attitudes and even poor mathematics achievement are not only as a result of the nature of the subject but pegged on the teaching strategies and approaches that teachers use. He noted that for a change, teachers need to stop using traditional approaches like copying from the board and memorizing formulas which is considered monotonous and creates low motivation. They should instead avoid these so as to seek and instill more positive view of mathematics in their learners.

Scaffolding is one of the teaching strategies. It is a process that involves teachers modeling and/or demonstrating how to solve problems, and giving room for learners to put into practice what they have learnt by offering them support. Bruner (1961) stated that learners have a better opportunity in applying knowledge competently when they are accorded the needed and necessary support when they are learning something new. He recommended positive interaction and three modes of representation during teaching i.e. actions, images, and language. It is the use of various instructional techniques that enable students to progressively be stronger in understanding and ultimately gaining greater independence in the learning process. The role of a teacher, therefore, becomes provision of support in mathematics learning mainly by summarizing knowledge, and emphasizing on critical points. The jigsaw technique on the other hand is a teaching strategy involving classroom organization where learners are trained and made to rely and depend on one another for progress and success (Aronson, 2000). Based on various factors such as strength, gender, speed in understanding and participation, classes are split into groups that can help in making a whole jigsaw puzzle. Each member is given a significant role to play and depend on each other. This technique not only mandate help to group members to work together in completing tasks and achieving the set goals but also encourage the members to actively listen, engage one another, and empathize. Tate and Phillips (2010) outlined in the 20 proven brain-compatible strategies that teachers find concrete in engaging learners in teaching mathematics with visual, auditory, kinesthetic, and tactile experiences that maximize retention. These strategies foster better competences in mathematics, and they included mnemonics, humor, manipulative and models.

2.2 Theoretical Framework

This article is anchored on Lev Vygotsky (1978) Social Development Theory which postulates that social interaction at various levels of development of learners' play a key role to cognitive development as it is explained by the concept of Zone of Proximal Development (ZPD). Vygotsky introduced the idea of ZPD that signifies the distance of gap between the actual and potential level, between what a child is able to do alone and what he/she can achieve through problem solving under an adult guidance or in collaboration with more experienced or capable peers. The ZPD include a range of very complex tasks to be mastered independently by a child but can be realized with adult guidance or associations with knowledgeable peers. Vygotsky accentuated that teaching

and learning are highly social activities, therefore, learners achieve their goals through interaction with teachers, peers and materials. He believed that pupils typically learn vicariously through one another. Vygotsky maintained that adults (teachers and parents) as well as peers promote children's cognitive development by assisting them with challenging tasks that will enhance mathematics competencies.

The concept of zone of proximal development lay emphasis on the construction of knowledge within a cooperative environment (Wells and Claxton, 2002) and it underlines that learning development is the result of interaction between the child and his/her environment (Vygotsky, 1978). A child can master knowledge, skills or strategies when they get guidance from an adult or peer either directly or indirectly (Westwood, 2004). Therefore, the relationship between peers and that of teacher-pupil as well as the environment will affect the acquisition of early mathematics competencies.

3. Materials and Methods

The research design used in this study was correlation study. It is a non-experimental research method that assesses the relationship between two variables. This research design was appropriate since the researcher sought to describe the relationship that occurred between teaching strategies and pupils' early mathematics competencies.

This research was carried out in Kipkelion sub-county which is located in Kericho County. Uwezo (2010) revealed that only 34% of pupils in standard three could perform numeracy tasks in Kericho sub-county (currently Ainamoi and Kipkelion sub-counties). Furthermore, Kandie, Begi, and Kangethe (2014) in their study on the relationship between lower primary school teachers' mathematics self-efficacy and their pupils' performance in mathematics in Kericho sub-county found out that mathematics was poorly performed in both primary and secondary schools in the sub-county. The researcher therefore selected Kipkelion sub-county to establish the relationship between teachers' use of teaching strategies to enhance mathematics competencies and grade three pupils' acquisition of early mathematics competencies.

The target population was 4,140 grade three pupils enrolled in 81 public and 23 private primary schools in Kipkelion sub-county as shown in Table 1. Grade three was chosen because pupils at this level have cumulatively acquired the requisite mathematical competencies before joining upper primary level.

Table 1: Enrollment of Pupils in Grade Three in Kipkelion Sub-County

Type of School	Number of Schools	Enrollment
Public	81	3,537
Private	23	603
Total	**104**	**4,140**

The researcher purposively sampled Kipkelion sub-county because it had the lowest mean score of 50.09 in mathematics in the year 2013 within Kericho County as shown in

Table 2. This was based on the evaluation of KCPE results in 2013 by the Director of Education, Kericho County.

Table 2: Mathematics Mean Scores in Respective Sub-Counties in Kericho County in 2013

Sub-County	Mean score
Ainamoi	56.54
Belgut	54.72
Bureti	55.28
Kipkelion	50.09
Londiani	50.19

Stratified random sampling was used to classify the schools into strata of non-overlapping homogeneous groups of public and private primary schools. The schools were selected from each stratum using simple random sampling. According to Gay, Mills, and Airasian (2012) a sample size of 10%-20% of the target population in a survey research is sufficient. In this study therefore, 20% of the schools in the two strata were sampled because they were representative enough for the study as shown in Table 3.

Table 3: Sample Size

Type of School	Number of Schools	Sample Size (Schools)	Number of Sampled Pupils
Public	81	16	579
Private	23	5	105
Total	**104**	**21**	**684**

The sample size was 16 public and 5 private primary schools. The sampled schools had 579 pupils from public and 105 from private primary schools giving a total of 684 pupils who participated in the study.

The researcher used self-constructed questionnaires, mathematics competency checklists and observation schedules as tools for collecting data. The questionnaires were administered to teachers handling grade three pupils and were used to collect information on teaching strategies. The researcher collected data on the level of acquisition of early mathematics competencies of each pupil in grade three by using mathematics competency checklists. The levels were based on four categories of responses; below expectation, approaches expectation, meet expectation and exceed expectation. Observation schedules were used to observe the type of teaching strategies used by teachers while presenting their mathematics lessons in the sampled primary schools.

The collected data was summarized and analyzed by using descriptive and inferential statistics respectively. The descriptive statistics used included frequency tables and texts. Pearson's Product Moment Correlation was used to measure the relationship between teaching strategies and pupils' mathematics competencies.

4. Results and Discussions

Questionnaires were utilized in collecting data where grade three teachers were to rate in a scale of 1 to 5 the use of teaching strategies. The results were as presented in Table 4.

Table 4: Teachers' Frequency on Use of Teaching Strategies to Enhance Pupils' Early Mathematics Competencies

Teaching Strategy	Never		Rarely		Sometimes		Often		Always		Total
	Count	%	Count	%	Count	%	Count	%	Count	%	%
Scaffolding	0	0.0	35	5.1	32	4.7	93	13.6	524	76.6	100
Jigsaw	156	22.8	181	26.5	214	31.3	108	15.8	25	3.7	100
Mnemonics	491	71.8	101	14.8	92	13.5	0	0.0	0	0.0	100
Manipulatives	0	0.0	41	6.0	161	23.5	196	28.7	286	41.8	100
Humor	0	0.0	0	0.0	0	0.0	76	11.1	608	88.9	100

It is evident from Table 4 that more than three quarters of teachers used scaffolding as a teaching strategy while about one third sometimes used jigsaw. About three quarters of the teachers never used mnemonics while about 42% of teachers always used manipulatives as a teaching strategy. Humor was a common teaching strategy that was used by about 90% of the teachers. Although scaffolding and humor teaching strategies are the most commonly used, teachers should be encouraged to put effort in using the rest of the strategies.

Observations were also conducted to compare the results from those of questionnaires. The researcher while observing the mathematics lessons noted that grade three teachers were humorous throughout their lessons. This made their pupils enjoy their lessons. It was observed that teachers explained mathematical concepts and thereafter gave problems to pupils to work on their own what they had learnt but occasionally offering them support. Hence, pupils were very active doing assignments throughout the lessons.

To establish the extent teachers used teaching strategies, teachers' overall mean scores in the use of teaching strategies were generated. The results were as presented in Table 5.

Table 5: Teachers' Mean Scores in the Use of Teaching Strategies to Enhance Pupils' Early Mathematics Competencies

Teaching Strategy	Total			
	Minimum	Maximum	Mean	Standard Deviation
Scaffolding	2	5	5	1
Jigsaw	1	5	3	1
Mnemonics	1	3	1	1
Manipulatives	2	5	4	1
Humor	4	5	5	0
Averages	2	5	4	1

As presented in Table 5, scaffolding and humor were the two strategies which were always used by teachers as both had an individual mean of 5 while mnemonics had 1 meaning they were never used. The table also shows that the average mean score in teachers' use of teaching strategies was 4 with a standard deviation of 1. The results, therefore, imply that majority of teachers often used teaching strategies.

The researcher had to ascertain whether the relationship between strategies used in enhancing teaching of mathematics and pupils' acquisition of early mathematics competencies was significant. A null hypothesis which stated that *there is no significant relationship between use of teaching strategies for enhancing understanding of mathematics and pupil's acquisition of early mathematics competencies* was formulated and tested.

The researcher used Pearson's Product Moment Correlation to establish whether the relationship between use of teaching strategies for enhancing understanding of mathematics and pupils' acquisition of early mathematics competencies was significant and the results were as presented in Table 6.

Table 6: Relationship between Teachers' Use of Teaching Strategies to Enhance Mathematics Competencies and Pupils' Early Mathematics Competencies

		Average Math Competence	**Average Strategies**
Average Math Competence	Pearson Correlation	1	.138**
	Sig. (2-tailed)		.000
Average Strategies	Pearson Correlation	.138**	1
	Sig. (2-tailed)	.000	

**. Correlation is significant at the 0.05 level (2-tailed).
b. Listwise N=684

As shown in Table 6 the correlation coefficient between teachers' use of teaching strategies to enhance pupils' mathematics competencies and pupils' acquisition of early mathematics competencies was .138, with a p-value of .000. The results imply that the correlation was highly significant, hence the null hypothesis was rejected and its alternative which stated that there is a relationship between teachers' use of teaching strategies to enhance pupils' acquisition of early mathematics competencies was accepted. It therefore implies that to enhance pupils' acquisition of early mathematics competencies teachers should strengthen the use of teaching strategies.

The findings of this study are consistent with those reported by Kioko (2015) in his study on the influence of learner classroom activities on mathematics competency among pre-school children in Lower Yatta sub-county, Kenya. Kioko established that young children require objects to manipulate in order to enhance their mathematics competencies while the findings of the current study showed that more than 70% of the teachers used manipulatives. The findings of Owegi (2016) in her study on the relationship between teachers' use of learning materials, teaching strategies and pre-school children's performance in mathematics in Nairobi County, Kenya also agree with the findings of the current study. The findings indicated that there was a significant

relationship between teaching strategies and children's performance in mathematics. The results are consistent with that of Arends, Winnaar, and Mosimege (2017) who conducted a study on the teacher classroom practices and mathematics performance in South African schools which indicated that there was a positive association between teachers' choice of strategies and pupils' competence. Similarly, they found that the strategies teachers choose had a big impact on learners' mathematics competencies and hence agree with the findings of the current study. Mwololo (2017) did a study on strategies for enhancing performance in mathematics for learners with hearing impairment in primary schools in Makueni County, Kenya. Results indicated that the strategies teachers choose have a big impact on mathematics competencies.

5. Conclusion

Results revealed that the relationship between the use of teaching strategies for enhancing understanding of mathematics and pupils' acquisition of early mathematics competencies was significant and hence had a positive influence. Therefore, teachers should attend in service training and workshops in order to update their teaching strategies. Teacher training institutions should also train teachers with enhanced skills on teaching approaches.

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