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APPLICATION OF PROGRESSIVIST'S LEARNER-CENTERED APPROACHES IN TEACHING AND LEARNING OF MATHEMATICS IN PUBLIC PRIMARY SCHOOLS

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ABSTRACT
This study assessed application of Progressivism`s Learner-Centered approaches of teaching mathematics among pupils in public primary school in Meru South Sub-County. It employed descriptive survey research design. The target population was 5,547 subjects of which 5,160 were pupils and 387 were teachers from all the public primary schools within Meru South Sub-County. Purposive sampling techniques and simple random sampling were used to obtain a sample size of 378 respondents. The study employed two sets of questionnaires to collect data, one for pupils and the other for mathematics teachers. Teacher-centered teaching and learning approaches were applied to a great extent in Meru South Sub-County. Factors hindering application of Progressivists' learner-centered teaching and learning approaches included scarcity of teaching resources, large class sizes and wide mathematics syllabus. Pupils should be encouraged to read mathematics textbooks, make their own notes and conclusions. The study provides valuable reference for various education stakeholders such as the teachers, curriculum developers and policy makers on learner-centered approaches to enhance teaching of Mathematics.
Keywords: Progressivist's Learner-Centered, Mathematics Public Primary Schools

INTRODUCTION
Education is the principal motivating factor behind national economic development and is one of the most effective ways in which individuals can achieve better opportunities and higher standards of living. The Millennium Development Goal targets to ensure that all children complete a full course of primary education. Primary education, or elementary education, fulfils the special needs of pupils during the first few years of their schooling life (Antler, 1982). The skills and values that primary education instills are foundational and serve as bases for all future learning, whether formal or informal.

There exists a close relationship between Mathematics and other disciplines meaning that a learner, who is doing well in Mathematics stands at higher chances to have high scores in other disciplines (Romberg, 1984). Society regards mathematics as the foundation or a wheel to higher technological and scientific knowledge that is essential in socio-economic development of any economy. There is a general agreement

in any society that mathematics should be compulsory to every child at school in order to acquire the necessary skills for coping with adult life (Dewey, 1951). Teaching mathematics to children from kindergarten using multiple teaching strategies will optimize their learning (Samuelsson, 2008).

Philosophy of progressivism proposes ways of teaching and learning through basing instructions on the needs, interests and developmental stages of the child (Dewey, 1944). The major proponents of this philosophy are John Dewey and William Heard Kilpatrick, who have emphasized on the relationship between children`s growth process with the knowledge acquisition process (Bryant, 1997). This means promoting discovery and self-directed learning by the student through active engagement; it means that learners should only be taught the skills they need for them to learn any subject as opposed to transmitting a particular subject. Antler (1997) summarizes progressivism as 'child-centered instruction', 'discovery learning' and 'learning how to learn'. In United States of America, (Chaka, 1997) noted that pupils work on their projects enthusiastically during the learning process rather than memorization when learner-centered methods of learning are employed. Research carried out by (Romberg, 1984) indicated that according to the American curriculum, regular classroom students just memorized what they needed to know, which they soon forgotten after the test. In South Africa philosophy of progressivisms' emphasis on learner-centered theory has been noted to yield high ideals of educational revolution that has made most pupils to be successful learners (Ball, 2003). According to research findings, proper implementation of the progressivism theory in some schools, led to good performance in science-related subjects especially in Mathematics (Abercrombie, 2000).

Statement of the Problem

Mathematics is essential in acquisition of scientific and technological knowledge, which is vital socio-economic development of an economy. However, performance in Mathematics at the Kenya Certificate of Primary Education examination has been declining over the years. The consistent poor achievement has been blamed on several factors that range from inadequate teaching and learning resources to use of teacher-centred approaches. This study assessed the application of Progressivists' Learner-Centered approaches of learning and teaching mathematics to pupils in public primary schools.

LITERATURE REVIEW

Philosophy of Progressivism emphasizes on teaching based on the interests, needs, experiences and abilities of learners. The proponents of this philosophy emphasis on learning based on the belief that knowledge isn't a thing that can simply be given by the teacher at the front of the room to students in their desks. Rather, knowledge is constructed by learners through an active, mental process of development; learners are the builders and creators of meaning and knowledge (Felder and Brent, 1996). According to the philosophy of progressivism, pupils should be taught how to solve problems in classroom for them to acquire the necessary skills to help them solve the problems that they encounter in their everyday lives. As (Radu, 2011) emphasized the goal of this philosophy is to expose the learner to the subject matter of social experiences, social studies, projects, problems, and experiments that, when studied by the scientific method will result in knowledge that learners will be able to use in future.

Proponents of philosophy of progressivism, John Dewey and William Kilpatrick emphasized on development of learners' contact with the world and support them to have both direct and indirect contact with the world in order to learn through their personal contact and experiences with the world (Kilpatrick, 1947). Elliot (1999) emphasizes that learners should take the knowledge gained and apply it in solving real life problems and they should become aware of their achievements. The school curriculum according to progressivism should be built around measurable data rather than simply the teaching of subject matter. According to (Mayer and Hegarty, 1996), learners must understand the directly measurable aspects of the adult world and they should be assessed in a measurable way so that teachers can focus on developing their skills rather than simply teaching subject matter.

Learning by Doing Approach (LDA)

Learning by doing is a teaching and learning approach that has been applied for many years. This approach has many proponents, including Thomas Hobbes, cultural anthropologists, B. F. Skinner, English and Spanish epigrammatists, Plato, Karl Marx, Montessori, Mao Zedong and John B. Watson. LDA has many forms which includes, practical experience versus book-learning, discovery versus instruction, proof upon practice and practice-theory-practice dialectic. As (Kilpatrick, 1951) noted, learning by doing, also referred to as experiential learning is an approach where students learn through doing activities by themselves. This forms a cycle, whereby the teacher explains something, the students process it, they then learn through their actions and process again. This gives a more complete knowledge base in a given subject, meaning it is an advantageous teaching methodology. Kilpatrick (1936) noted that based on the philosophy of progressivism, the active teaching techniques involved change the learning atmosphere of the classroom, and they help to increase learners' motivation, involvement, attention, excitement, and perceived helpful as well as applicable in class.

In other words, learning by doing means learning from experiences as a direct result of one's own actions, which is the best way of acquiring knowledge as compared to learning from reading others' instructions or descriptions watching others perform, or listening to others' instructions or lectures? Although watching, reading, and listening are actions, according to Radu (2011), they are not the kinds of actions described to as learning by doing since they are similar with demonstrations or descriptions of actions rather than with actions. This means that the learner actually does not perform but sees the performance.

Collaborative Learning Approach (CTA)

Collaborative learning and teaching method involves a variety of learner-centred teaching and learning methods that involves joint intellectual participation by either pupils or their fellow pupils or between pupils and teachers together. In order for collaborative learning to be effective, Kilpatrick (1926) emphasized that pupils ought to work in groups of two or more, with the objective of mutual search for knowledge, understanding, meaning and solutions to solve problems. The learning activities involved in collaborative learning vary widely with the subject matter but most of them are centred on pupils' exploration or application of the subject matter as opposed to teacher's presentation of the same. In addition, collaborative activities also include classroom discussions interspersed with short lectures and sometimes through entire class periods (Martin, 1959). The processes and goals of collaborative activities vary widely as some instructors design small groups in a way that they will work around tightly structured tasks with agenda of developing student interests or questions (Kilpatrick, 1949).

Collaborative learning by its very nature, involves both social and intellectual skills (Chandra and Sharma, 2004). It allows learners to get involved in learning activities with other students, get involved with instructors, which are the factors that mainly make difference in learner's retention and success in college. Consequently, collaborative learning activities invite learners to establish closer relationship and connections with other learners, their instructors and their courses.

Problem Solving Approach (PSA)

Children need problem-solving skills and should start developing them from a young age (Bryant and Nunes, 1997). Philosophy of progressivism points out that children who learn to solve problems are often less violent when they are older because conflict resolution has been ingrained. Kilpatrick (1936) suggested that parents can help children develop the problem solving skills as soon as they are old enough to communicate, often by calmly intervening and asking questions about how a problem might be solved. An important part of intelligence is the ability to solve problems more quickly and creatively. (Dewey, 1944) identified problem solving as an excellent skill to pupil`s in their everyday life and in the workplace. After all, problems present themselves unexpectedly and in a variety of contexts. If the pupils are trained their brains in the raw, foundation-level skills needed to solve problems, they will increase their general problem-solving ability, regardless of whether the problem is at home, at school, or somewhere in between.

Kilpatrick (1951) noted oftentimes that with problem solving, there is no clear-cut solution to the problem or scenario that is presented. As a result, having a preset grouping of problem solving steps can help your class to reach a solution.

METHODOLOGY

This study employed descriptive survey research design. This research design was chosen because it allows the researcher to study the phenomena without manipulation of the variables. Mayer and Hegarty (1996) noted that descriptive research determines and reports the way things are, the researcher examined the approaches used in teaching and learning of mathematics in primary schools with respect to the defined study variables. This research design helped to record, analyze and interpret the status of the variables in order to come up with accurate, valid and reliable report. The independent variables in this study were Progressivism`s learner-centered approaches whose indicators include learning by doing approach, problem solving approach and collaborative learning approach. The dependent variables were teaching and learning of mathematics in primary schools whose indicators are teaching methods and activities. Two methods of technical philosophy; critical analysis and conceptual analysis approach were used to reinforce the research design to enhance elaborate description of the phenomena under study.

Sampling Procedures and Sample Size

Simple random sampling was used to obtain the sample. (Kathuri and Pals, 1993) recommends that from an accessible population of 5,547, a sample size of 341 respondents is sufficient. The researcher added 37 respondents in order to cater for attrition to give a sample size of 378 respondents. This comprised of 40 pupils and 2 teachers from each primary school. Given an average of 40 pupils in every class, 9 primary schools were selected using stratified sampling technique in order to ensure that all divisions within Meru South Sub-County were covered in the study. Purposive sampling was used to select class 7 pupils and mathematics teachers from each of the 9 selected schools. In schools with more than one stream for class 7, simple random sampling technique was used to select one stream. Class 7 pupils were selected because they are the second senior most class and were also not engaged in KCPE during the year hence they had time to respond to the questionnaire.

Data Analysis

Data Analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data. The researcher started the data analysis process by cleaning the data before assigning code number to each answer in the questionnaires. The coded data was entered to a computer for analysis using the Statistical Package for Social Science (SPSS) Version 20. Quantitative data was analyzed usingpercentages and frequencies while qualitative data was analyzed using thematic approach as guided by the objectives of the study. The findings of data analysis were presented using bar graphs, frequency tables and charts.

RESULTS AND DISCUSSION

A total of 352 pupils took part in the study. According information represented on Fig. 1, majority (56%) of the pupils were males while their female counterparts formed 44% of the pupils sampled.

The total number of pupils who took part in the study was 352 where majority (56%) was males and 44% were their female counterparts as shown in Figure 1.

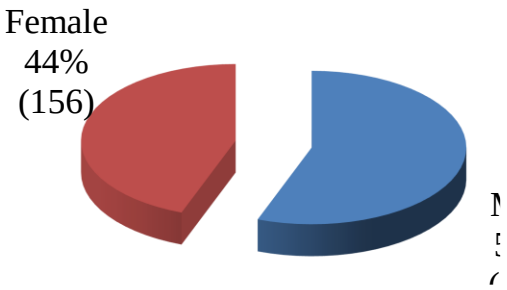

Figure 1: Distribution of pupils by gender

Based on the research findings, majority of the pupils sampled (65.1%) were aged between 13 and 14 years those who formed the minority were aged between 19 and 20 years and constituted 0.3% of the sample. This agrees with the philosophy of progressivism which emphasizes that learner-centered teaching and learning approaches should be applied more to young learners aged 15 years and below as compared to their old and mature counterparts.

The total number of mathematics' teachers who participated in the study was 17 of which the males were the majority (76%) and the female were minority (24%). The study required mathematics teachers to provide their age in the questionnaire. The findings are shown in Table 1.

Table 1: Age distribution of teachers (N=17)

Age (years)	Frequency	Percentage %
20-30	6	35.4
30-40	4	23.5
40-50	4	23.5
50-60	3	17.6
Total	17	100.0

The information in Table 1 shows that 35.4% of the mathematics teachers were within the age bracket of 20 to 30 years while 17.6% of the teachers sampled were within 50 to 60 years.

The study findings show that 35% of the mathematics teachers sampled were qualified with diploma, 18% were untrained and those who held bachelors' degree comprised 18% of the teachers sampled. An item on the teacher's questionnaire inquired on the duration served in their current stations and results illustrated in Table 2.

Table 2: Duration served by mathematic teachers (N=17)

Duration (years)	Frequency	Percentage %
0 – 3	7	41.2
4 – 6	5	29.4
7 – 9	3	17.6
10 and above	2	11.8
Total	17	100.0

Based on findings in Table 2, 41.2% of mathematics teachers had served on between 0 to 3 years in their current station. Those mathematics teachers who had served for 10 years and above in the current station were the minority (11.8%). In addition, mathematics teachers were required to state their teaching experience and the findings are illustrated in the tables below.

Regarding teachers' use of demonstrations during mathematics lesson, it was noted that 54.3% of the pupils sampled and 71.4% of the teachers felt that it was applied to a very great extent. On giving mathematics homework to learners, 53.3% of the teacher respondents felt that it was applied to a great extent. The researcher enquired on the extent of application of the problem solving approach in teaching and learning of mathematics. The study findings showed that 66.7% of the teachers sampled and 61.4% of the pupils sampled indicated that teacher's guidance on solving mathematic problem was applied to a very great extent. The study enquired on the extent of application of the collaborative learning approach in teaching and learning of mathematics. The study findings revealed that 33.3% of the teachers sampled and 28.8% of the pupils agreed strongly that peer teaching in mathematics was applied to a small extent.

Study findings revealed that demonstration was applied to a very great extent in teaching and learning of mathematics. However, the researcher noted that demostration method was applied by the teacher with less participation of the learners. One of the progressivists' guiding principle states that ideas are constructed or made meaningful when children integrate them into their existing structures of knowledge. The philosophy of progressivism advocates for pupils to be given homework on regular basis in order to give them opportunity of constructing and innovating new ways of solving problems. According to Ball, Hill and Bass (1995) teachers and parents should be answerable for non-completion or erroneous work, and this helps pupils in being more responsible for their schoolwork and other home activities. The research findings indicated that counters were applied to a small extent during learning of mathematics. According to Kilpatrick (1949) objects such as counters and the activities that emphasize on patterns should be used in teaching of Mathematic to children. This helps them to establish mathematical skills by showing the order and progression that is necessary for basic mathematics functions such as addition and subtraction.

The study findings revealed that on the application of learner-centred problem solving approaches in teaching and learning of mathematics, 46.7% of the teachers sampled and 23.2% of the pupils sampled noted that it was applied at no extent and in small extent respectively. The progressivists' view of learning argues that learners do not come to the mathematics classroom empty-minded but arrive with lots of strongly formed ideas about how the natural world works. Pupils should not be passive recipients of knowledge and formulae supplied by teachers but they should derive theirs. The importance of understanding mathematics formulas was emphasised by Baldacchino and Farrugia (2002) who posits that learners should understand how to derive and manipulate formulas by writing the formula again and again as it is the most effective way of familiarizing with any formula.

The study findings on collaborative learning showed that 43.8% of the pupils sampled and 42.9% of the teachers sampled felt that solving mathematics problems in groups was applied in small extent. In addition, 28.6% of the teachers sampled and 30.1% of the pupils sampled indicated that holding mathematic contests with other schools was done to a small extent. A large number of respondents did not have opinion on mathematic contests with other schools. Philosophy of progressivism emphasizes mathematics learner-centered models where learners collaborate and compete with others in order to form an active part in the acquisition of their own mathematical knowledge. In addition, progressivist's proposed that the peer teacher and learner should engage in a cooperative and active process of constructing knowledge. Philosophy of progressivism further states that whether working in small or large groups, peer teacher and learners should be the audience for one another's comments and they should speak to one another, aiming to convince or to question their peers. The peer teacher of mathematics should create a learning environment that fosters the development of each learner's mathematical power.

Holding mathematics contest and competition with pupils from other schools was noted to be applied to a small extent in primary schools within Meru South Sub-County. An according to (Chaka, 1997) holding mathematics contest with other schools helps students to gauge their ability in different environment. Progressivists' learner-centered approaches advocates for activities that unite learners from different cultural and economic backgrounds, schools and religion in order to enable them gain problem-solving

skills as well as the ability to do critical analysis on a given set of data. As a result, these skills enable the learner to develop their character building, potential interests and abilities in their future careers and adapt to a constantly changing real-world environment.

Responses from both pupils and teachers agreed that demonstration and problem solving approaches were applied to a great extent. According to Kilpatrick (1932) lack of pupils' direct involvement in the activities hinders them from learning how to clearly articulate their ideas as well as to collaborate on tasks effectively by sharing the burden of group projects. The other progressivists' learner-centered approach namely collaborative learning was either applied at small extent or no extent. Learners must be guided to exchange ideas and they should therefore learn how to "negotiate" with others through discussion groups in order to evaluate their contributions in a socially acceptable manner. The researcher noted learner-centered approaches were not applied as recommended in the philosophy of progressivism.

The findings of this study indicated that majority of the primary school pupils rely on teachers wholly to provide knowledge since learning is basically teacher-centered. Teaching mathematics using teacher-centered approaches such as memorization and lecture approaches leads to dogmatism, memorization of rules and formulae, guess work, evaluation based on answers with no regard to methodology and consequently, this paused a possible cause for the poor performance. Application of learner-centered teaching and learning approaches as espoused in the philosophy of progressivism would not only lead to good performance but would also sharpen pupils` skills on creativity, socialization, collaborative learning, innovation and problem solving.

RECOMMENDATIONS

(i) To enhance application of learning by doing approaches, the teacher should coach a student volunteer through the demonstration, experimental and construction processes then leave the pupils to perform the exercise on their own to consolidate learning. This is advantageous because students may not truly understand a concept until they have manipulated it for themselves.

(ii) To avoid mathematics teachers playing central roles during the problem solving processes, pupils should be taught how to identify the mathematical operations needed to solve the problem. This should be done through a combination of key words, drawing pictures and acting out the problem with manipulative and creative approaches. In addition, teachers should ensure that pupils always use a combination of methods to arrive at the correct operation in order to increase their general problem-solving ability, regardless of whether the problem is at home, at school, or somewhere in between.

(iii) To enhance application of Progressivists' learner-centered approaches in teaching and learning of mathematics, pupils should be encouraged to read mathematics textbooks, make their own notes and conclusions. Pupils should be given mathematics homework regularly where they should generate problems and come up with solutions.

CONCLUSION

The findings of this study indicated that majority of the primary school pupils rely on teachers wholly to provide knowledge since learning is basically teacher-centered. Teaching mathematics using teacher-centered approaches such as memorization and lecture leads to dogmatism, memorization of rules and formulae, guess work, evaluation based on answers with no regard to methodology and consequently was a possible cause for the poor performance. Pupils had developed negative attitude towards mathematics despite the philosophical link between mathematics and other subjects, that a pupil who is performing well in mathematics, is more likely to have high scores in other subjects. Application of learner-centered teaching and learning approaches as espoused in the philosophy of progressivism would not only lead to good performance but would also sharpen pupils` skills on creativity, socialization, collaborative learning, innovation and problem solving.

Competing Interests

Authors have declared that no competing interests exist.

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