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CRITICAL ANALYSIS ON HOW TEACHER-RELATED FACTORS AFFECT APPLICATION OF PROGRESSIVISMS' LEARNER-CENTERED APPROACHES IN TEACHING AND LEARNING OF MATHEMATICS: A CASE OF MERU SOUTH SUB-COUNTY, THARAKA NITHI COUNTY, KENYA.

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ABSTRACT
Learning mathematics` problem-solving skills using learner-centered teaching approach, as emphasized in the philosophy of progressivism, enhances creativity and problem solving skills to the learners. In contrast, learning mathematics using teacher-centered approaches have increasingly dire consequences to the pupils such as poor performance, lack of creativity, poor socialization and lack of problem-solving skills. This study critically analyzed how teacher-related factors affect application of learner-centered approaches in teaching and learning of Mathematics. The study employed descriptive survey research design. The target population comprised of 5,547 subjects consisting of 5,160 pupils and 387 teachers from 129 public primary schools within Meru South Sub-County, Tharaka Nithi County, Kenya. A sample size of 378 respondents was obtained using simple random sampling and purposive sampling techniques. Questionnaires were used to collect data from pupils and mathematics teachers. The results of the data analysis were presented using bar graphs, frequency tables and charts. The research findings revealed several learner-related factors such as motivation, attitude, beliefs and myths on mathematics, which were noted to make pupils participate passively in the learning process. Pupils' negative attitude towards mathematics was also noted as a major hindrance to the application of Progressivists' learner-centered approaches in teaching and learning of mathematics in Meru South Sub-County. The researcher anticipates that the findings and recommendations of this study may provide valuable reference for teachers, curriculum developers and policy makers in education on learner-centered approaches to enhance teaching of Mathematics.
Keywords: *Philosophy of Progressivism, Learner-Centered, teaching, learning*

INTRODUCTION
Children, because of their individual personalities, require instruction that address several learning attributes (Holt, 2004). Some characteristics of young children include shorter attention spans, less experience with social interactions and basic skills in the classroom and an inability to understand lengthy, complicated directions (Holt, 2004). Although children use a variety of skills to learn new information, younger children have a limited vocabulary; hence, it is important to teach without relying

solely on verbal instructions (Elliot, 1999). Teacher–centered teaching methods such as rote learning, lecture method and memorization makes the learner to be passive in the learning process and encourages dogmatism. In learner-centered teaching approaches such as group discussion, learners are encouraged to cooperate with their classmates and with their teachers.

Progressivism is a philosophy, whose major proponents are John Dewey and William Heard Kilpatrick, relates children`s growth process with the process of acquiring knowledge (Kilpatrick, 1951). According to Dewey (1944), philosophy of progressivism suggests ways of teaching and learning through basing instruction on the needs, interests and developmental stages of the child. It means teaching students the skills they need in order to learn any subject, instead of focusing on transmitting a particular subject; it means promoting discovery and self-directed learning by the student through active engagement. Kilpatrick (1951) summarizes progressivism as 'child-centered instruction', 'discovery learning' and 'learning how to learn'.

In United States of America, Radu (2011) observed that through learner-centered methods of learning, pupils work on their projects enthusiastically for learning to take place, rather than memorization. Before learner-centered approaches were introduced in the American curriculum as asserted by Radu (2011), regular classroom students just memorized what they needed to know and was soon forgotten after the test. In South Africa according to Hayes (2007), progressivism as learner-centered theory with high ideals of educational revolution that make each and every child to be a successful learner. Thus, proper implementation of the progressivism theory in some schools, led to good performance in science-related subjects especially in Mathematics (Hayes, 2007).

Statement of the Problem

Mathematics is the foundation of scientific and technological knowledge that is vital in socio-economic development of a nation. Despite government's efforts to enhance the use of learner-centered teaching and learning approaches, performance in Mathematics at the Kenya Certificate of Primary Education examination has been declining over the years. In the long run, pupils may miss out on admission to high schools and due to low achievement in mathematics. The persistent poor performance has been blamed on several factors that are teacher-related, curriculum-related and learner-related. This study therefore seeks to assess and provide a critical analysis how teacher-related factors affect application of progressivisms' learner-centered approaches in teaching and learning of mathematics.

Purpose of the Study

The purpose of this study was to assess and provide a critical analysis how learner-related factors affect application of progressivists' learner-centered approaches in teaching and learning of mathematics among pupils in public primary school in Meru South Sub-County.

Objectives of the Study

The study was guided by the following specific objectives.

(i) To identify learner-related factors that affect application of progressivists' learner-centered approaches in teaching and learning of Maths in public primary schools in Meru South Sub-County.
(ii) To critically analyze how the identified learner-related factors affect application of Progressivists' learner-centered approaches in teaching and learning of Mathematics among pupils in public primary schools of Meru South Sub-County.

LITERATURE REVIEW

Philosophy of Progressivism

Progressivism is a philosophy that emphasizes on teaching based on the needs, experiences, interests, and abilities of learners. Progressivists' 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 (Kilpatrick, 1926). Bruffee (1984) noted that through progressivists' learner-centered teaching and learning approaches, children learn to identify obstacles that hinder their learning and then work on solutions to overcome them. It equips the children

with skills not just to take on obstacles in their learning process, but also the obstacles in life. In this way, learners acquire skill sets that are necessary y to handle different situations in school and life. The progressive method adopts a unique teaching philosophy centered around projects, analysis of data, understanding problems and their solutions and answering questions after careful analysis of facts at hand (Biggs, 1995). This allows children to learn concepts and content without resorting to memorization but by gaining, a deeper understanding of the content learner-centered approaches namely; Learning by doing, collaborative learning and problem-solving approach.

Learning by Doing Approach (LDA)

Learning by doing is a teaching and learning approach that has been applied for many years. It has many proponents, including Plato, Thomas Hobbes, English and Spanish epigrammatists, Karl Marx and Mao Zedong, cultural anthropologists, Montessori, John B. Watson, and B. F. Skinner. Learning by doing approach has many forms, including discovery versus instruction, practical experience versus book-learning, the practice-theory-practice dialectic, and proof upon practice. Laturner (2002) noted that very few learner-centered teaching methods are used today in public schools that include the learners being able to actually do what they are being taught. This could be because of the complexity and time it adds to lesson plans, additional materials required, time allowed for assessments, inexperienced educators or traditions in the education field. Learning by doing allows a learner to practice and become confident in their ability to perform. It not only allows the teacher to assess if they are meeting the teaching goals of the course but also allows the student to be able to do what they have spent their time and possibly money to learn; so that they can use the skills, they have learned after they have completed the course. Abercrombie (2000) noted that anyone can have students read from a book, hand out a test and give out grades, but every teacher cannot complete the tasks being doing all the activities on the chalkboard, let alone be experts in the field they are experts.

Demonstration Method

Demonstrations involve activities that occur in the classroom as a means of helping learners understand how a phenomena 'works' (Biggs, 1995). This method is more active than lecture method because pupils get involved and they see in first-hand how the construction or phenomena present itself in the real world. Kilpatrick (1951) emphasize that after demonstration, the teacher should task the pupils to review key points in the class. If a significant number of pupils missed or misunderstood any key points, the teacher may need to repeat the demonstration process. As a follow-up exercise, pupils should apply the concept to a new situation so they can generalize their learning (Dewey, 1938). For technique demonstrations, it is often helpful for pupils to watch the teacher coach a student volunteer through a technique. Then the pupils should perform the technique on their own to consolidate learning.

Demonstrations are usually the teaching and learning technique that involves all of the students in the class, either working in groups or alone, to solve a problem or puzzle. The benefit of demonstrations is not only that it increases attention and students are able to see a phenomena unfold, but are also able to personally manipulate and practice using that phenomena in a first-hand environment (Phillips, 2000). This is advantageous because students may not truly understand a concept until they have manipulated it for themselves (Whetten and Clark, 1996). Examples of in-class activities can range from playing games as exam reviews (Cook and Hazelwood, 2002; Saranson and Banbury, 2004) to in-class journaling (Bolin, Khramtsova, and Saarnio, 2005).

Collaborative Learning Approach (CTA)

Collaborative teaching approach is a term for a variety of learner-centred teaching methods involving joint intellectual effort by pupils, or pupils and teachers together. In collaborative learning, Dewey (1944) recommended for pupils to work in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Nurrenbern and Robinson (1997) noted the main limitation of applying collaborative learning approach and group discussions as they are normally conducted is that there is no individual accountability at all. The result is the familiar situation in which some team members do the bulk of the work, others contribute little and understand little or nothing about the project, everyone gets the same grade, and resentment abounds. Adjusting the team project grades for individual performance goes a long way toward correcting these injustices. In addition, it is

good practice to include some individual testing on every aspect of the project and have the results count toward the final course grade (Giangreco, 1993). If this is done, hitchhikers who understand either nothing or only the little they did personally will be penalized and perhaps induced to play a more active role in subsequent work.

Progressivists advocates forming discussion teams heterogeneous in ability level. The unfairness of forming a group with only weak students is obvious, but groups with only strong students are equally undesirable (Golub, 1988). The members of such teams are likely to divide up the homework and communicate only cursorily with one another, avoiding the interactions that lead to most of the proven benefits of cooperative learning. In heterogeneous groups, the weaker students gain from seeing how better students approach problems, and the stronger students gain a deeper understanding of the subject by teaching it to others (Nurrenbern and Robinson, 1997). Moreover, when graduates go to work in industry or business, they will be required to work in teams and will have no voice in the team formation, and their job performance evaluation will depend as much on their ability to work with their teammates as on their technical skills (Johnson and R.T, 1989). Since that's what they'll be doing then, the job of their instructors is to prepare them for it now.

Teachers' Related Factors

According to Brown (2010), the greatest factor in teaching process is the teacher. No methods, no techniques, no gadgets, no devices can guarantee pupils' success; only the teacher can. Agyeman (1993) noted that a teacher who does not have both academic and professional teacher qualifications would have negative influence to his/her subject. A teacher must be enthusiastic about his/her subject and in case he/she does not consider it as one of the most important thing, pupils may not get inspired (Sharma, 2008). Eshiwani (1983) noted that poor performance is due to teachers' characteristics such as teaching experience, certification, training, pupil-teacher ratio, professional commitment and transfer index.

Theoretical Framework

This study was informed by the Progressivism theory whose major proponents are John Dewey and William Kilpatrick. The progressivism theory states that the learning process starts with self-appropriation of knowledge, construction of problems and provision of possible solutions by the learners themselves (Kilpatrick, 1947). The theory is based on philosophical approach referred to as Pragmatism, which states that an ideology or proposition is true if it works satisfactorily. Kilpatrick (1939) noted that in order to participate successfully in a progressive environment, classrooms must shift from a passive to an active role. Progressivism theory emphasizes that learners should synthesize several sources of information and references in order to draw conclusions and then evaluate them (Dewey, 1938). The theory advocates for learner-centered teaching approach where students learn through action and involvment in processes that will get to the end product rather than memorization.

Progressivism theory is relevant to this study since it emphasizes on learner-centered teaching approaches such as collaborative learning, experimentation, group discussions, demonstration and contextual learning. The theory has special focus on the learner that allows them to exercise their brain through problem solving and critical thinking to enhance effective learning. Consequently, learner's brain develops and hence preparing the learner for real world and many of the everyday setbacks. In teaching mathematics, progressivisms stress that learner should construct new ideas to help one to have a better understanding of reality.

RESEARCH 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. The independent variables in this study were Progressivism`s learner-centered approaches while the dependent variables were learner-related factors. 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.

Conceptual Analysis Approach

The conceptual analysis approach involves breaking down the main ideas into constituents through the process of analysis and synthesis. The main aim of conceptual analysis approach is to clarify the language used as well as analyzing the concepts expressed in it. In order to clarify the concepts such as learner-centered approaches, teaching and learning, it was necessary to use conceptual analysis approach. According to Ogola (2011) some of the philosophical problems are as a result of the complexities of the language since certain concepts may have several uses and hence it may be a fallacy to the users. Conceptual analysis was used to ensure that whatever was said about the concepts was said clearly in order to eliminate any possible fallacy.

Critical Analysis Approach

According to Njoroge and Bennaars (1986) the critical analysis approach points to positive evaluation as it seeks to evaluate and to judge things based on clear and distinct ideas. The approach is characterized by asking probing questions to establish merits and demerits of an issue, where answer to one question leads to another question. This approach was used in making rational judgments on how the philosophy of progressivism has affected mathematics teaching in Primary schools.

RESEARCH FINDINGS AND DISCUSSION

Pupils' Demographic Characteristics

An item on the pupil's questionnaire inquired on their gender. Figure 1 illustrates the gender composition of the pupils' respondents.

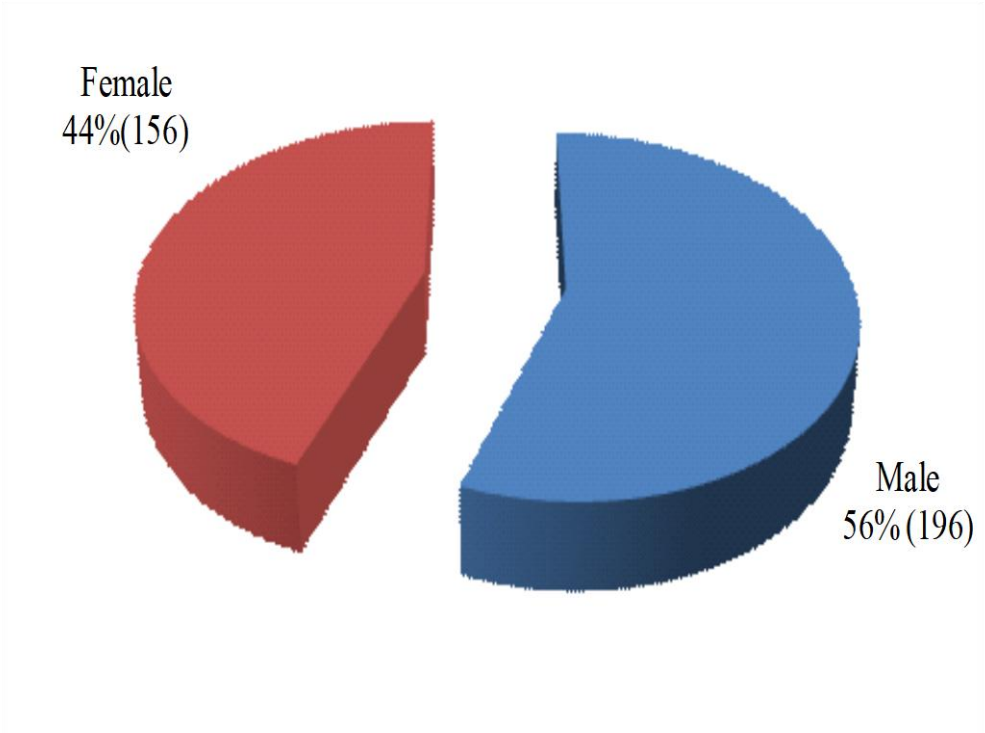

Figure 1. Distribution of Pupils by Gender

A total of 352 pupils took part in the study. According information represented on Figure 1, majority (56%) of the pupils were males while their female counterparts formed 44% of the pupils sampled. An item in the pupils' questionnaires enquired about their age and the findings are illustrated in Table 1.

Teachers' Demographic Characteristics

An item on the teacher's questionnaire inquired on their gender. Figure 3 illustrates the gender composition of the teachers sampled.

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 3.

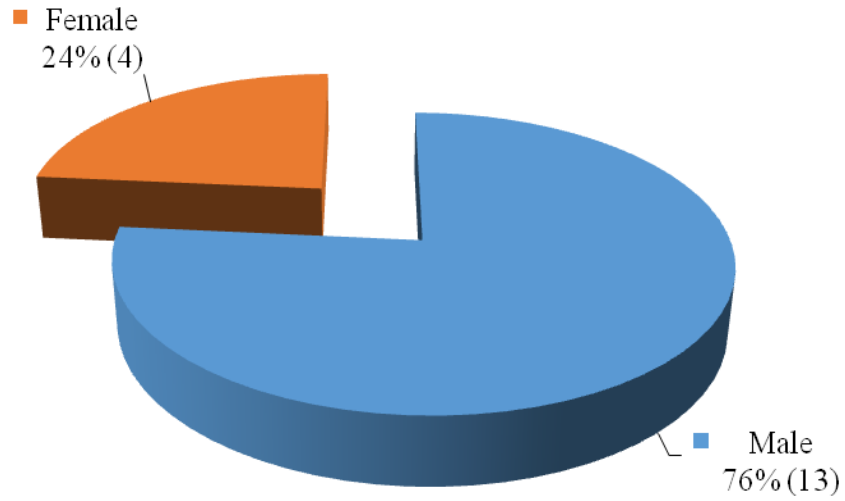

Figure 3. Distribution of Mathematics Teachers by Gender

Table 3. Age Distribution of teachers

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 3 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 profession qualification of the mathematics teachers are presented on Figure 4.

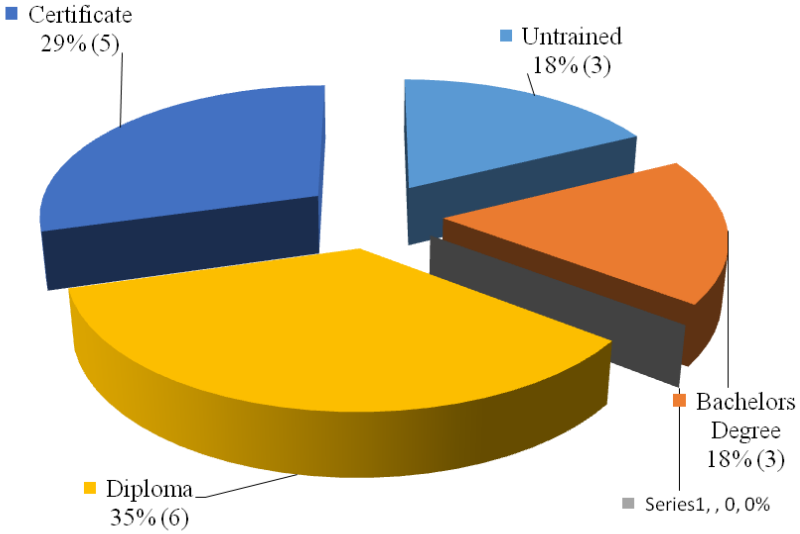

Figure 4. Professional Qualification of Mathematics Teachers

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 4.

Table 4. Duration served by mathematic teachers

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 4, 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 Table 5.

Table 5. Mathematic teachers' teaching experience

Duration (Years)	Frequency	Percentage
Less than 5 years	3	17.6
5 – 10	9	52.9
11 – 15	2	11.9
15 and above	3	17.6
Total	17	100.0

The findings in Table 5 show that 52.9% of the mathematics teachers had teaching experience ranging between 5 to 10 years. Mathematics teachers whose teaching experience ranged between 11 to 15 years were minority constituting 11.9% of the teachers sampled. In Progressivism point of view, experienced teachers are the best in conducting learner-centered approaches since they possess the necessary teaching skills. It has also been found out there exists a positive relationship between teachers' experience in teaching methods and learners' attitude towards learning of mathematics (SMASSE, 1998).

Teachers' Related Factors

The fourth objective of the study was to critically analyze the teacher-related factors and how they affected application of Proggressivit's learner-centered approaches in teaching and learning of Mathematics. The questionnaire contained open-ended questions that enquired on how the given teacher related factors namely: teachers' qualification, experience, preparation, beliefs and attitudes affected teaching and learning of mathematics among pupils in public primary schools of Meru South Sub-County, Kenya. The findings are summarized in Table 6.

Table 6. Teachers' opinion on teachers related factors

Teachers Related Factors	Agreed (%)	Disagreed (%)
Qualification	100	0
Experience	88.2	11.8
Preparation	88.2	11.8
Beliefs and Attitudes	88.2	11.8

Table 6 summarizes the findings of the teachers' opinion on those who agreed and disagreed that the given teacher-related factors affect application of progressivists' learner-centered approaches in teaching and learning of mathematics. Several points were noted regarding effects of teachers' qualification on teaching and learning of mathematics. It was noted that teachers who had good background in mathematics were highly motivated when teaching the subject than those who performed

poorly. However, teachers with poor background in mathematics were noted to lower pupils attitude in learning the subject. On the other hand, teachers with degrees and specialized in mathematics taught with ease than untrained teachers who lacked enough knowledge on the relevant teaching techniques as compared to trained teachers and hence they teach based on their own opinion and convinience.

The researcher noted that Meru South Sub-County experienced low teacher to pupils' ratio which contributed to hiring of untrained and inexperienced teachers. Teachers' qualification, experience and attitude towards mathematics were not considered when hiring the teachers by schools' board of management. Smith (1992) refers to mathematics knowledge for teaching as knowledge that is specific to the profession of teaching and is closely linked to student achievement. In a study carried by Ball (2005), on the effects of teachers' knowledge on students' achievements, the results showed that teachers who scored higher on mathematics knowledge also produced learners with better grades than their counterparts who scored low on mathematics knowledge. Ball (2001) argues that mathematics instruction is effective through the use of reform ideas as well as using strategies which all depend on teachers' knowledge of mathematics. Teachers' knowledge is pivotal in their capacity to provide effective mathematics instruction and to their ability to influence learners' attitude.

The study findings shows that 88.2% of the teachers agreed that teachers' experience affected application of progressivists' learner-centred approaches in teaching and learning of mathematics where several points were mentioned to back the responses: Teachers with more than ten years experience in teaching mathematics had good mastery of the subject and taught with ease; explanations and activities given in class by experienced teachers were said to be clear and made pupils to enjoy learning. The respondents noted that the more experienced a mathematics teacher was, the more easily he /she understood pupils' learning behaviour and hence chose the most appropriate teaching approach that fit individual leaner. Experienced mathematics teachers were noted to be motivated especially when conducting practical lessons and demonstrations since they were aware of the results and hence did not fear for possible disappointment. In addition, teachers with long time teaching experience were said to have personal experiences with different teaching approaches and were more likely to choose those that would boost learners' understanding.

Philosophy of progressivism states that teacher's role is not only to observe and assess but also to engage with learners as they complete learning activities while posing questions to them for promotion of their reasoning. Teachers' experience in guiding and supervising learners is therefore regarded as a major asset to their careers. However, the findings in Table 5 show that majority of mathematics teachers in Meru South Sub-County have short-time experience of between 0-3 years. You (2009) describe experience as a long period of practice for a period of five years or more during when an individual, who is skilled, takes in developing an activity, or mastering a process. Madsen and Cassidy (2005) claim that experienced teachers are more critical in their classroom teaching than untrained teachers. Learners find the course materials given by experienced teachers interesting and meaningful and explanations as well as activities given in class are clear (Madsen and Cassidy, 2009).

Teachers agreed that teachers' beliefs and attitudes affected application of progressivists' learner-centered approaches in teaching and learning of mathematics and they had severel responses: the ability to solve mathematics problems is hereditary not learned; men are better in solving mathematics problems that ladies; the main objective of doing mathematics is getting the answer; the ability to solve mathematics problems requires good memory; some people have a "math mind" and some do not; there is a magic key to doing maths. Progressivits hold that teachers' belief and attitude about mathematics largely shapes the pedagogy they use hence the response they obtain from their students. Relich (1994) observes that a positive teachers' attitude contributes to the formation of pupils' positive attitudes towards mathematics.

Critical analysis of the responses from mathematics teachers portrayed negative beliefs towards mathematics which confirmed the source of their pupils' negative attitude and their low performance in mathematics. This implies that teachers' attitude towards the subject produces the same attitude on the learner. Biggs (1995) shows that classroom strategies used to teach are influenced by teacher attitudes,

which in turn influence pupils' attitudes. Ernest (2000) noted that teachers who hold more learner-cantered, socio-constructivist oriented beliefs would translate into their classroom practices greater enthusiasm towards actively engaging their learners in acquiring mathematical concepts and developing mathematical thinkers and problem solvers.

On the effects of teachers' preparation on teaching and learning of mathematics, majority of the teachers agreed that it affected application of progressivists' learner-centred approaches in teaching and learning of mathematics and several points were noted from teachers: teachers preparation through lesson plan result to effective lesson presentation while taking into concern various learners' needs; teaching preparation enable teachers to allocate sufficient time to different topics using the most appropriate teaching approach; teachers' preparation and planning make it possible for enough time to be set for practicals and for learners' individual learning; teachers' preparation enable him /her to take into account variables such as pupils' ability levels, pupils' previous experience, and availability of resources before mathematics lesson. This enables teachers to play their different roles such as setting the stage, guiding, supervising individual and group work, controlling the class and allocating roles to pupils.

During the teachers' interview, more teachers' related factors were observed that affected teaching and learning of mathematics were noted. Majority of the teachers complained that their income was small and demotivating despite the high cost of living hence demotivating them. Teachers stated that they were forced by circumstances to seek for alternative sources of income in order to complement their income, which lead to absenteesm in schools and low teaching morale. The interviewees mentioned that the teacher-pupil ratio was declining following introduction of free primary education in 2003 when the number of pupils has increased at a higher rate than teachers. This compelled teachers to apply teacher-centered approaches such as lecture method despite their ineffectiveness in teaching mathematics. To mitigate the impact, school managements opted to hire untrained teachers, who had limited knowledge on learner-centered teaching and learning approaches, which are the best for learning mathematics.

Further critical analysis of the findings revealed that majority of primary schools mathematics teachers in Meru South Sub-County lacked motivation, which leads to poor planning and lack of adequate preparation for their mathematics lesson. Cook and Hazelwood (2002) claimed that teacher preparation is vital for effective teaching and learning process. Planning is a requirement for any program to succeed as it is an arrangement or a method for doing something. Since planning is a future intention to act in a certain way in order to achieve set objective, it is a process of arranging and organizing how to do something carefully in advance (MoEST, 2001). Inadequate teachers' preparation was an indication of extensive usage of teacher-centred teaching approaches within the area of study given that learner-centred approaches demands for thorough preparation prior to the actual lesson.

As advocated in Progressivists' learner-centered approaches, Kilpatric (1951) said that as one plans for a group of learners he/she needs to engage in "task-analysis", which requires the teacher to take the content that is to be taught; first, identify the desired results from learning of the content; secondly, break the content into smaller components or sub- tasks that logically build towards the desired results; and finally, define appropriate teaching approaches for each of the components and specify lesson objectives.

Several teacher-related factors of teachers' qualification, experience, preparation, beliefs and attitudes affect application of Proggressivists' learner-centered approaches in teaching and learning of Maths.

RECOMMENDATIONS

Following the findings, the following recommendations were made:

- To avoid mathematics teachers playing central roles, pupils should be taught how to identify the mathematical operations needed to solve the problem. This should be done through a combination of keywords, 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.

- To enable the teachers provide individual attention to learners, curriculum planners, developers, and designers should consider several factors in mathematics syllabus such as every topic to be accompanied with practical lesson, content to be reduced for quality coverage and class size to be less than 40 pupils.

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