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# Evaluation of Teacher Factors Associated with Mathematics Performance in Primary Schools in Kenya

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## Abstract

The focus of this study was to investigate teacher-related factors associated with performance in mathematics in public day primary schools in Nandi Central district, Kenya. Seventy-four (74) mathematics teachers participated in the study. Stratified, random, and purposive sampling techniques were used to obtain the samples for the study. Data collection was done using questionnaire which had been validated and subjected to a pilot study to establish its reliability. Each subscale of the questionnaire yielded a Cronbach's alpha reliability coefficient of 0.60 and higher. The study employed the descriptive statistics and inferential statistic (t-test) to analyze gathered data. The study revealed that the majority of mathematics teachers in Nandi Central district public day primary schools were trained with a teaching experience of between 11–20 years. However, they gave an average rating on the mathematics teachers' use of learning resources, teaching methodology, teacher preparation, commitment, and assessment and evaluation. Further, teachers in high performing schools rated the attitudes toward mathematics, teaching methodology, commitment, preparation, and use of learning resources, evaluation and assessment higher than their counterparts in the low performing schools. Future research ought to link research on teacher preparation with teacher induction with professional development.

**Keywords:** Performance, mathematics, learning resources, attitude, teacher preparation, Kenya

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## INTRODUCTION

Mathematics study has long been recognized worldwide as important in the understanding of other subjects like chemistry, biology, and physics. Salau (2000) points out that there exists an impregnable link between mathematics and other science subjects. For example, the teaching of practical aspect of chemistry can hardly be achieved without the knowledge of mathematics. He concludes that there is a relationship of mathematics' ability on students' overall outcomes. That is to say, a student who is performing well in mathematics is most likely to have high scores in overall outcomes.

In Kenya, mathematics is a prerequisite subject to many advanced careers like medicine, pharmacy, and other business courses (accounting, finance, and banking). One has to score high in mathematics for him or her to be allowed to pursue any of the above careers (University of Nairobi, 2008).

According to Baldacchino and Farrugia (2002), the quality of education cannot be seen or improved by simply providing physical resources like books, extending duration of learning, training more teachers and providing other learning resources, but by teachers interpreting the learning to the pupils and appropriately using teaching and learning approaches. It is the teacher who has to establish the right climate for learning, use learning resources and appropriate teaching methods to attainment of mathematical greatness (Baikie, 2000).

Onwuakpa and Nweka (2000), state that mathematics learning largely depends on the teacher. The job of a teacher is to impart knowledge, skills, attitudes and mathematical concepts into the learner. To achieve this, teachers are advised to give assignments, projects and tests to their pupils and discuss the results with them.

Performance in mathematics has remained of a global concern. Studies conducted by American Institute for Research (AIR) to investigate mathematics performance on USA students – 4$^{th}$ and 8$^{th}$ grades as compared with their peers around the world and another by National Assessment of Education Progress (NAEP) assessed the progress in mathematics of students in grades 4, 8, and 12. The results showed that grade 4 pupils performed below the average mark consistently from 1996-2007. The survey also revealed that teachers are the major cause of poor mathematics performance in the US (AIR, 2007). In another study, Schmidt et al. (2002) found out that teachers in USA follow text books which are too wide because publishers produce elementary mathematics text books that cover a variety of topics so that they can sell in different states. As a result, teachers do not develop in their pupils a deep conceptual understanding of mathematics topics and their application (Schmidt, Houang, & Cogan, 2002).

According to Opolot-Okurut et al. (2008), the public in Uganda continues to decry the poor performance of pupils in national mathematics examination. In his study at Makerere University, Opolot-Okurut investigated factors that hinder pupils' opportunities to learn mathematics in primary schools. The findings revealed that 83% of the factors that hinder mathematics' learning are teacher-related factors, which include: poor teaching methods, lack of teaching experience, teachers' weak academic background, poor teacher attitudes towards mathematics, and lack of a continuous professional development.

According to Prof. Kiptoon, former Permanent Secretary in the Ministry of Education, the poor performance in primary mathematics is largely caused by teachers (MoEST, 2001). He claims that most teachers teaching the subject are unskilled, incompetent, and lack expertise. This is the reason why the government in 2001, through the Ministry of Education, introduced a distance learning course called 'School Based Teacher Development' to improve primary school teachers. The aim of the course was to help teachers understand how pupils learn mathematics and to equip teachers on how to provide support for their pupils' learning of mathematics (MoEST, 2001)

Ngirachu (2010), in an article entitled "*Children troop to school, but still illiterate*" featured in the *Daily Nation* of Friday, April 23, 2010, reported a study that was conducted by a team of researchers from Kenyatta University and non-governmental organization called *Uwezo,* which covered 70 districts. This study interviewed 40,386 pupils and revealed that "one out of 10 standard eight pupils could not solve a class two mathematical problem, 30% of class five failed the same sum, and 20% of class two were able to solve it.

The *Standard Newspaper* on Thursday, 26$^{th}$ August 2010, in an article entitled "*Some teachers weaker than their pupils,*" reported a study that was conducted by African Population and Health Research Centre (APHRC, 2010). The report pointed out that teachers who were supposed to impart knowledge to the students could be the source of poor performance in mathematics. The organization tested mathematics skills in a study covering 72 primary schools, 2,437 pupils and 211 teachers. The results indicated that the average score was 60% for teachers and 46% for pupils, with some teachers scoring as low as 17% (pp. 1-4).

In Kenya, poor performance in mathematics at Kenya Certificate of Primary Education (KCPE) has been and still is a subject of much debate among politicians, teachers, parents, educational experts, and other stake holders. In the year 2005, 671,417 pupils sat for KCPE exam in Kenya, and the mathematics raw mean was 46.9%. In the year 2006, 660,531

pupils sat for the exam and the mathematics raw mean was 53.94%, while in the year 2007, 698,364 pupils did the exam and obtained a percentage raw mean of 49.24% (Ministry of Education, 2010)

Nandi Central District registered 4,779 candidates for the year 2009 KCPE and mathematics mean score was 52.71. In 2008, 4,673 candidates were registered and they attained a mathematics mean score of 53.27, while in the year 2007, 4,566 candidates sat for the exam, and attained mathematics mean score of 53.25%. In 2006, there were 4,398 candidates and they got 53.78%, and in 2005, 4,269 pupils sat for the exam and obtained a mean score of 52.49. This is an indication that mathematics is poorly performed in the district (DEO, Nandi Central, 2010).

It was therefore necessary to assess and compare teacher factors associated with primary school pupil's performance in mathematics in order to discover whether there exist any differences between the ratings of teachers' variables in high and low performing primary schools in Nandi Central District.

The following null hypothesis was tested: There is no significant difference between the evaluation ratings of mathematics teachers of high performing schools and low performing schools in Nandi Central District in each of the following teacher-related variables:

- Teacher attributes ( attitudes and commitment)
- Teacher preparations
- Teachers' use of learning resources
- Teaching/instructional strategies
- Evaluation/assessment methods

## THEORETICAL FRAMEWORK

This study was guided by the social constructivism theory, a theory that was developed by Vygotsky and Wood (1998). According to Jonassen (1999), constructivism is a synthesis of multiple theories diffused into one form. It is the assimilation of both behaviorists and cognitive ideals. The constructivist stance maintains that learning is a process of constructing meaning; it is how people make sense of their experience. Jonassen (1999) further observes that constructivism is a learning theory that gives teachers another perspective to rethink how students learn and to focus on process and provide ways of documenting change and transformation. It also reminds teachers to look for different ways to engage individual student, develop rich environments for exploration, prepare coherent problem sets and challenges that focus the model building effort, and elicit and communicate student perceptions and interpretations.

In his theory, Vygotzy observed that when children were tested on tasks on their own, they rarely did as well as when they were working in collaboration with an adult. It was by no means always the case that the adult was teaching them how to perform the task, but that the process of engagement with the adult enabled them to refine their thinking or their performance to make it more effective. Hence, for him, the development of language, arithmetic and articulation of ideas was central to learning and development (Atherton, 2010).

The theory is considered to be related to the teaching and learning to a large extent. Constructivism is not a specific pedagogy, but it has a wide ranging impact on learning theories and teaching methods in education. The constructivism view involves two principles. First, knowledge is actively constructed by the learner, not passively received from the environment. Knowledge is a changing body not fixed. Secondly, knowledge is internalized by learners in a social atmosphere, combining previous experience and contribution from all members in the social group (teachers and peers). Knowledge is formed by the process of combining experience and previous learning with ideas presented to the learner by instructors (Atherton, 2010)

Social constructivism views learners as unique individuals with unique needs and background, a complex and multidimensional. It acknowledges not only the uniqueness and complexity of the learner, but also encourages, utilizes and rewards it as an integral part of the learning process (Wertsch, 1997).

According to constructivism view on teaching resources in mathematics, mathematics systems are learned throughout the learners' life as he/she interacts with knowledgeable members of the society (Wertsch, 1997). The learner, according to Von Glaserfeld (1998), should be actively involved in the learning process, not the traditional method where the instructor is to teach and the learner play a passive, receptive role. All senses should be utilized in the learning process.

In the constructivist classrooms' methodology, the teachers' role is to prompt and facilitate learning. The main teacher focus should be on guiding pupils by asking questions that will lead them to solve a given problem by their own. The learning environment should be designed to support and challenge the learners' thinking (Jonassen, 1999).

According to Doolittle and Camp (1999), teaching students to learn in a constructivist methodology requires consideration by the teacher. Teachers serve as guide or facilitators of knowledge, learning environment should be authentic, lessons should be relevant to students, and they should be encouraged to reflect upon what they learn and be encouraged to be reflective and finally be evaluated to discover their future educational needs.

## LITERATURE REVIEW

### Teacher Commitment

Numerous authors and researchers agree that teacher commitment is central to the work of teaching and functioning of education system. Elliott and Creswell (2002) argue that teacher commitment and engagement have been identified as amongst the most critical factors in the success and future of education. It contributes to teacher's work performance, absenteeism, burnout, and turnover as well as having an important influence on student achievement.

Becker (1999) defines commitment as the investment in a particular career, in this case, teaching. Lortie (1995) regards commitment as the willingness an individual enacts in investing personal resources to the teaching task. Nias (1991) looks at teacher commitment like an organizational commitment, which is conceptualized as being multidimensional.

Joffress et al. (2006) wrote that teachers' commitment is a crucial factor to an effective school, teacher satisfaction, and retention. They claim that low levels of teacher commitment results into decreased student achievement tests, than in areas where teachers were found not to be committed to their responsibilities, learners performed poorly.

It is important to note that teachers' commitment to their duties is quite significant to pupils' performance. Committed teachers tend to produce good results at national examinations. Woods in Truman et al. (2008) in the study entitled *"primary teacher commitment and attractions,*" claims that teacher commitment takes three forms, with the most important one being professional commitment. They argue that a professionally committed teacher rates their teaching abilities very highly and are committed to their professional advancement.

Day, Elliott, and Kingston (2005) argue that there are different forms of commitment to teaching. According to them, the nature and intensity of commitment to teaching depends on factors derived from personal and professional lives. Commitment is a word they use to distinguish those who are caring, dedicated, and who take their job seriously from those who put their own interest first. The professionally committed teachers take their job seriously and they get enjoyment from it (Elliott & Croswell, 2001).

It is believed that teacher commitment decreases progressively over the course of their career (Frazer et al., 1998). At the beginning of the teacher's career, Frazer argues that teacher's commitment is associated with professional identity, followed by a stage of experimentation and research for new challenges. Thus, transition from an enthusiastic engagement with the profession to a more limited involvement reduces teacher's classroom practices and engagement. Joffress, et al. (2006), in a study entitled "*elementary teachers' commitments decline," f*ound that teachers who served in rural schools for more than six years reported a high level of commitment to teaching which appears to increase as teaching experience increases.

Nias (1991) and Tyree (1996) wrote that teachers who are committed are those who see their students' welfare; they care for, responding to, and meeting students' needs. They strived to improve on their practice and look at pedagogies and research. They also talk and listen to their children, at the same time they work as a team with others, appropriately prepared for their lessons, and are reflective practitioners. Another view shared by committed teachers is that teaching is not just a job. Teachers invest their personal time even outside school contact hours. They have made teaching as a lifestyle. They often contemplate on their class programs and students while engaging in a range of personal activities like in shower, shopping, or watching television (Tyree, 1996).

### Teacher Beliefs and Attitudes

Beliefs are defined as personal constructs that provide an understanding of a teacher's practice. Perry and Howard (1999) argue that the pedagogy used in the classroom is determined by the philosophies the teacher holds about mathematics. That is to say, the teacher's belief about mathematics has great impact on the teaching of mathematics and learning of mathematics in the classroom. Cobb (1996) argues that teacher beliefs about mathematics and the learning of mathematics impinge on students' beliefs and goals within the subject area. This shows that teacher beliefs and attitude about mathematics largely shapes the pedagogy they use hence the response they obtain from their students.

Charalambos, et al. (2002) and Ernest (2000) argue that teachers' beliefs about mathematics *have* a powerful impact on the practices of teaching. A teacher with negative beliefs about mathematics influences his or her learners negatively, whereas the learners of teachers with positive beliefs about mathematics enjoy and successfully perform in mathematics. They conclude that what goes on in the mathematics classroom is directly related to the beliefs teachers hold about mathematics. Researchers like Askew et al. (1997) and Beswick (2007) agree to that teacher beliefs such as nature of mathematics and the capacities of their students to learn mathematics influence their practices in teaching the subject. If a teacher has a positive belief that his or her students will achieve in the subject, definitely he will influence higher achievement. At the same time, if his feelings about the subject are negative – that mathematics is hard, definitely he will impact the same to his/her learners.

Other researches claim that teacher beliefs relate to teacher classroom practice (Thompson, 1992; Kagan, 1992). Fang (1996), on the article entitled "*A review of research on teacher beliefs and practice,"* argues that teacher beliefs and attitudes significantly contribute to enhancing educational effectiveness and achievement. A strong positive belief causes higher achievement among students. Relich et al. (1994) observes that a positive teacher attitude contributes to the formation of pupils' positive attitudes. Carpenter and Lubinski (1990) show that classroom strategies used to teach a subject are influenced by teacher attitudes, which in turn influence pupils' attitudes. This implies that teacher attitudes towards the subject actually produce the same attitude on the learner. It is therefore assumed that teachers who hold more learner-centered, 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 (Ernest, 2000).

**Teacher Experience**

You (2009) describes experience as a long period of practice over a period of ten years, or more, an individual who is skilled takes in developing an activity, or mastering a performance. Madsen and Cassidy (2005) claim that research findings have shown that experienced teachers are more critical in their classroom teaching than pre-service teachers. Learners find their course materials given by experienced teachers interesting and meaningful. They find that explanations and activities given in class by this category of teachers are clear.

Clotfelter et al. (2007) performed a longitudinal analysis of a 10-year administrative data set from North Carolina and concluded that teacher experience had positive impact on student mathematics achievement. Klecker (2008), in his research paper entitled '*Teacher quality of eight-grade math achievement,'* presented at the annual meeting of mid-south Educational Research Association, argued that the eighth-grade students who were taught by teachers with 20 and above years of experience had the highest average scale scores.

**Teacher Qualification**

The No Child Left Behind Act (NCLB) defines teacher-quality variables as:
(1) the highest academic degree, (2) type of teaching certificate, (3) major/minor in mathematics, and (4) number of years a teacher taught mathematics (NCLB, 2002). Klecker (2008) conducted a study using a secondary analysis of the 2007 National Assessment of Educational Progress (NAEP). Results were reported in terms of statistical significance. This study found out that an eighth-grade mathematics teacher is more effective with (1) either a major or minor in mathematics, (2) a professional degree, (3) a regular/standard teaching certificate, and (4) with 20 and above years of experience in teaching mathematics. The teacher quality variables had an impact on the average scale scores of the student academic performance.

Teacher knowledge of mathematics is pivotal to their capacity to provide effective mathematics instruction and to their ability to access students' learning (Ball et al., 2005). The National Council for the Teaching of Mathematics (NCTM, 2000) makes it clear that teachers need knowledge about the important ideas that are central to their grade level. The measurement of teacher knowledge of mathematics has been a problem occupying researchers for several decades but they sort to use characteristics of teachers and their educational background. Other studies sought to focus on pedagogical content knowledge of teachers (Begle, 1999).

Rowan and Ball (2005) refer 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, et al. (2005), on the effects of teachers' knowledge on students' achievements, the results showed that teachers who scored higher on mathematics knowledge also produced better gains on student achievements. That is, their students achieved good grades than their counterparts who scored low on mathematics knowledge.

Goldhaber and Brever (2000) found out a positive relationship between this variable with higher levels of performance among students whose teachers held a bachelor's or master's degree in mathematics than among those whose teachers were out of field. They found out that those students whose teachers were certified in mathematics but did not hold post-secondary degree mathematics did not perform as well as students whose teachers held post-secondary degree mathematics. Ball et al. (2001) argue that mathematics instruction is effective through the use of reform ideas, using strategies and all depend on teachers' knowledge of mathematics. Darling–Hammond (2001), in his study relating to teachers' preparedness and effectiveness, found that teachers who are fully prepared through teacher education and licensing were more effective in their fields than those teachers who did not have much professional education. Wilson, et al. (2002) reported in their study that students of certified mathematics teachers scored higher on certified test than those of uncertified teachers.

**Teacher Preparation**

Armstrong, et al. (2009), indicates that in order to provide quality learning experience for all students, lessons must be well planned and prepared effectively. They describe responsibilities and characteristics of the 21st century teacher as: matching instructions and programs to learner's characteristic, conducting task analysis to identify an appropriate beginning point, and a logical sequence for instruction, specifying learning intentions. Lessons should be well prepared to suit the learners' capabilities and interests. Lessons must stimulate learners to want to learn the new information. Armstrong, et al. (2009) further confirms that as one plans for a group of learners he/she needs to engage in what is called "task-analysis activities." Task analysis requires that one takes the content that is to be taught and 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.

Once task analysis has been done satisfactorily, then follows lesson presentation. Effective lesson presentation, according to Armstrong, has several key elements that include stimulating and maintaining of interest. Content presented should interest and motivate individual learners. The teacher has to use a variety of approaches to motivate learners. Variety is essential because each learner's needs are unique. Motivation should be at the beginning of the lesson, during learning sequence, and finally, at lesson conclusion Finally, on sequencing of lessons, a lesson presentation follows a logical sequence. Information is presented in an organized manner, regularly checking pupils' understanding, providing an opportunity for practice, giving frequent feedback, and concluding lessons by reviewing main points (Armstrong et al., 2009). Planning is a requirement for any program to succeed. A plan is an arrangement or a method for doing something. It 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).

A scheme of work is a key planning document for all teachers. It is a personal plan to cover the syllabus, taking into account variables like time allocation, pupils' ability levels, and pupils' previous experience, available resources and putting content in a logical sequence. Other considerations involved in planning the scheme of work include scope to be covered, sequence, objectives, learning activities, learning resource and evaluation. Learning activities refer to the experience you give learners to support the learning of mathematics. They should be well thought out and planned in advance. The activities should be varied involving the child in a practical work, watching demonstration and problem solving and reinforcement activities. Mathematics lesson plan is a short, carefully developed and written outline designed to help the teacher achieve the objectives of a specific topic, skill, or idea (MoEST, 2001).

Indimuli et al. (2009) claimed that teacher preparation is vital for effective teaching and learning process. Effective teaching include: preparation, implementation, and evaluation. In preparation, they said that the teacher refers to the syllabus so as to make the scheme of work and lesson plans. In implementation, the teacher is involved in the actual teaching of the content, class management and uses teaching/learning materials to achieve the specified lesson objectives. Evaluation is administered in form of continuous assessment, and end-of-course examination.

They further describe teacher preparation to include class management. They define class management as involving the creation of a stimulating learning environment in which effective teaching/learning can take place. In order to achieve this, they say that it is advisable to consider grouping of pupils, observing class routine and class organization. On classroom organization, they say that seating arrangement needs to be done in groups. At the same time equipments specific to mathematics lessons should be placed in positions which are easily accessible (Indimuli et al., 2009).

**Assessment/Evaluation in Mathematics**

Accurate assessment of students' academic abilities has been identified as one of the most crucial variables related to effective instructional planning and positive student outcomes (Shinn, 1998). It has been argued that without a valid assessment of students' academic skills, instructional decision making is unlikely to promote academic competence (Martens & Witt, 2004). According to Stiggins et al. (2007), there are two kinds of assessment during instruction: assessment for and assessment of learning. Assessment for learning involves use of homework assignments, quizzes, and self assessment drafts. This kind of assessment is child centered and gives the learner an opportunity to find information about areas of strengths and areas of further learning. Assessment of learning is a periodical assessment like midterms and final examinations which are teacher centered and judgmental for they are meant to inform the final grade of the learner.

Stiggins et al. (2007) further described four fundamental questions that instructors (teachers) need to address whenever he/she plans for what they call accurate assessment and effective use which include the purpose of assessment, the learning target, the assessment methods and the ways of reporting the results. Ballard and Johnson (2004), in their educational research on mathematics assessment, confirmed that frequent quizzes do yield benefits. They compared test results of students who were exposed to quizzes with a control group who experience no quizzes. They found significantly higher scores for students who experienced quizzes and concluded that frequent quizzing influences learning performance. The mean scores for these students were significantly higher than for students in the control group who experienced no quizzes.

MoEST (2001) describes how assessment helps a teacher. A teacher is able to identify pupils' achievement, pupils' needs, weaknesses, and strengths. A teacher can carry out assessment either informally or formally. Informal assessment involves listening to pupil's explanations, demonstration or questioning pupils deliberately, while formal assessment is timed, marked and invigilated by external person. According to Indimuli et al. (2009), evaluation is a process of determining the extent to which the stated educational objectives are being achieved. Evaluation is done in order to: identify the knowledge, skills and attitudes that pupils have acquired, find out weaknesses and strengths of teaching strategies and learning resources used, motivate pupils as they prepare for a test or examination, help pupils to know their progress in specific areas, and provide a basis for promoting pupils from one level to another.

**METHODOLOGY**

This study employed causal-comparative and descriptive research designs. Causal-comparative research design is a non-experimental research method that provides better evidence of cause and effect relationship. According to Gay (2006), causal-comparative research design determines reasons or cause for the current status of the phenomena under study. Descriptive research design attempts to collect data from members of a population in order to determine the current status of that population in respect to one or more variables. According to Gay (2006), descriptive research determines and reports the way things are. It is intended to produce statistical information about aspects of education that interest policy makers and educators. It involves collecting numerical data to answer questions about the current status of the phenomena under study.

Descriptive method was used because it can tell what actually exists and helps to record, analyze, and interpret the current status (Mugenda & Mugenda, 2003) of the variables. The causal-comparative method was used in order to describe how teachers and pupils in each category of schools may differ in their evaluation of teacher-related factors hypothesized to be associated with performance in mathematics.

**Population**

The population in this research comprised of the mathematics teachers of public primary schools in Nandi Central district. In Nandi Central, there are 129 public day primary schools with about 640 mathematics teachers. The mathematics teachers were targeted because they were involved in the actual teaching and guiding the learning of mathematics in schools. They are responsible for planning and implementing the process of teaching of mathematics in schools.

**Sample and Sampling Techniques**

To obtain the desired sample in this study, purposive, stratified, and simple random sampling techniques were used. For the purpose of the study, the researchers chose to study public day primary schools. The researchers obtained a list of KCPE Examination analysis from the DEO for the last 5 years. They stratified them into two groups-high performers and

low performers. There were a total of 18 high performing schools and 31 low performing schools. The researchers obtained 30% of 49 schools to constitute a sample of 14 schools, seven from high performers which have maintained top position for the last five years and seven bottom low performers. The high performing schools in this study comprised of schools which had maintained a mathematics percentage mean score of above 60% and low performers being those schools which had scored a percentage mean score of below 50% in the K.CP.E for the last five years. The KCPE mean percentages for each school are shown in Table 1.

Table 1: *Mean Percentages in KCPE (2005-2009)*

| School Code | High Performing | Low Performing |
|---|---|---|
| 1 | 67.4 | 39.8 |
| 2 | 64.2 | 45.3 |
| 3 | 69.7 | 38.2 |
| 4 | 66.1 | 46.3 |
| 5 | 70.1 | 40.9 |
| 6 | 71.4 | 37.7 |
| 7 | 64.9 | 46.0 |

Since only 14 schools were under investigation, all mathematics teachers were involved in responding to the questionnaire; thus thirty eight (38) teachers from high performing schools and 36 from low performing schools participated.

**Research Instruments**

A Self-constructed questionnaire was used to collect data from mathematics teachers. The questionnaire had the following items: teacher attitudes, methods of teaching, use of learning resources, teacher commitment, and assessment and evaluation using the four-point scale of (4) Strongly agree (3) Agree (2) Disagree, (1) Strongly disagree (1) as well as (4) Often (3) Sometimes (2) Rarely (1) Never. The teachers circled the appropriate number to indicate their agreement or disagreement to the given statements.

To verify the instruments for content and face validity, the researchers consulted with a working group of scholars at the School of Education, University of Eastern Africa, Baraton. Content validity here is the degree to which the content of the instrument really measures teacher factors associated with performance in mathematics. Face validity refers to the likelihood that a question will be misunderstood or misinterpreted which was done by pre-testing the questionnaire and amending by deleting the ambiguous items as advised (Fraenkel and Wallen (1996).

**Reliability of Research Instruments**

Cronbach's alpha coefficient was employed to determine the internal consistency of the instrument. This is based on the relationship among the scores derived from the individual items or subsets of items within a test (Ary, Jacobs, & Razavieh, 2002). A computed alpha coefficient varies between 1 (denoting perfect internal consistency) and 0 (denoting no internal consistency).

A pilot study was carried out in a neighboring district. The questionnaires were administered to 20 mathematics teachers from four schools. The reliability coefficient for each section of the questionnaire addressing different variables was computed based on the responses of the teachers. The cut-off value for the reliability coefficient was set at 0.60. The sub-scales that had reliability coefficients lower than 0.60 had statements that were deleted. In the sub-scales on teachers' attitude and teaching methodology, one statement each was deleted, while in the sub-scale on teachers' use of learning resources, one statement was modified. The reliability coefficients were re-computed using the data in the final study and the new reliability coefficients were determined as shown below.

Table 2:*Cronbach's Alpha Reliability Coefficients*

| | Original | *Modified/Recomputed |
|---|---|---|
| Teachers' attitude | 0.770 | |
| Teaching methodology | 0.516 | *0.828 |
| Teachers' use of learning resources | 0.659 | |
| Teacher commitment | 0.667 | |
| Teacher preparation | 0.776 | |
| Assessment and evaluation | 0.739 | |

*Reliability coefficients after selected statement was deleted or modified and re-computed.

**Data Gathering Procedures**

After the establishment of the reliability of the instruments, the researchers secured permission from the National Council of Science and Technology, Ministry of Education to collect data from the teachers of public day primary schools. Also, a letter from the District Education Office (DEO) of Nandi Central District was solicited to introduce the researchers to the sampled schools in the district.

The researchers started to collect data from the concerned schools from April 13, 2010. The head teachers introduced the researchers to the teachers, requesting them to fill the questionnaire. The researchers assured the teachers that their responses were for purposes of research and would be treated with strict confidence. Seventy four (74) questionnaires were filled by the teachers.

**Statistical Treatment of Data**

Inferential statistics (t-test) was used to specifically determine if there was any significant difference between the ratings of mathematics teachers of high performing schools and low performing schools in each of the following teacher-related attributes (commitment, qualification, experience, and attitudes)

- Teacher preparation
- Teachers' use of learning resources
- Teaching strategies/methods
- Evaluation/assessment methods

**RESULTS AND DISCUSSION**

***Comparison on Attitude towards Mathematics***

Teachers' Self-evaluation on Attitude towards Mathematics

Table 3 shows the t- test analysis on teacher attitude towards mathematics based on teachers' self evaluation.

Table 3:*T-test on Teachers' Attitude towards Mathematics*

**Group Statistics (teachers' ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Teachers' Attitude toward Mathematics | High-performing | 38 | 3.9737 | .09899 | .01606 |
| | Low-performing | 36 | 3.4815 | .64584 | .10764 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Teachers' Attitude toward Mathematics | Equal variances assumed | 84.559 | .000 | 4.643 | 72 | .000 | .49220 | .10602 | .28085 | .70355 |
| | Equal variances not assumed | | | 4.523 | 36.558 | .000 | .49220 | .10883 | .27160 | .71281 |

The group statistics table revealed that teachers in high performing schools had a mean self-evaluation of 3.9737 while those in low performing schools have a mean of 3.4815. The t-test yielded a t-value of 4.523 with a *p*-value of 0.000, which is less than 0.05, implying that the null hypothesis was rejected, concluding that there was a significant difference between the self-evaluation ratings of mathematics teachers of high and low performing schools in terms of teacher attitude towards mathematics. The mathematics teachers in high performing schools had a more positive attitude toward mathematics than the teachers of low performing schools. As Cobb (1996) states, teacher beliefs and attitude about mathematics largely shapes the pedagogy they use, hence the response they get from the students.

### *Comparison on Teaching Methodology*

Table 4 shows group statistics and independent samples t-test on teaching methodology based on teachers' self-evaluation ratings.

Table 4:*T-test on Teaching Methodology*

**Group Statistics (teachers ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Methodology | High-performing | 38 | 3.6349 | .22583 | .03663 |
| | Low-performing | 36 | 2.3438 | .47615 | .07769 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Methodology | Equal variances assumed | 21.632 | .000 | 15.289 | 72 | .000 | 1.29112 | .08445 | 1.12277 | 1.45946 |
| | Equal variances not assumed | | | 15.031 | 49.958 | .000 | 1.29112 | .08590 | 1.11859 | 1.46365 |

Group descriptive statistics showed that teachers from high performing schools often used teaching methodologies as shown by a mean of 3.6349 as compared to low performing schools which shows that teachers rarely used stated teaching methods as indicated by a mean of 2.34. The t-test yielded a t-value of 15.031 with a *p*-value of 0.000, which implied that the null hypothesis was rejected and therefore there was a significant difference between the self-evaluation ratings of mathematics teachers of high and low performing schools in terms of teaching methodology in mathematics. The mathematics teachers in high performing schools agreed more on the use of teaching strategies reflected on the questionnaire than their colleagues from low performing schools.

***Comparison on Teachers' Use of Learning Resources***

Table 6 shows the t- test analysis on teachers' use of learning resources in mathematics based on teachers' self-evaluation.

Table 6: *T-test on Teachers' Use of Learning Resources*

**Group Statistics (Teachers' Ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Use of Learning Resources | High-performing | 38 | 3.4895 | .21659 | .03514 |
| | Low-performing | 36 | 2.0556 | .38429 | .06405 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Use of Learning Resources | Equal variances assumed | 6.904 | .011 | 19.909 | 72 | .000 | 1.43392 | .07202 | 1.29034 | 1.57750 |
| | Equal variances not assumed | | | 19.628 | 54.562 | .000 | 1.43392 | .07305 | 1.28749 | 1.58035 |

The group statistics table reveals that high performing school teachers sometimes used learning resources in mathematics as indicated by a mean of 3.489 while teachers in low performing schools rarely use learning resources in mathematics as shown by a mean of 2.0556. This suggests that teachers in high performing schools used teaching resources more often than the low performing schools. The t-test yielded a t-value of 19.628 with a *p*-value of 0.011, which implies that we rejected the null hypothesis and therefore, there was a significant difference between the self-evaluation ratings of mathematics teachers of high and low performing schools in the use of learning resources. The mathematics teachers in high performing schools often used learning resources reflected on the questionnaire than their colleagues from low performing schools.

***Comparison of teacher commitment***

Table 7 shows the t- test analysis on teacher commitment in mathematics based on teachers' self-evaluation.

Table 7: *T-test on Teacher Commitment*

**Group Statistics (teachers' ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Teacher Commitment | High-performing | 38 | 3.8684 | .20843 | .03381 |
| | Low-performing | 36 | 2.3810 | .42653 | .07109 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Teacher Commitment | Equal variances assumed | 22.766 | .000 | 19.217 | 72 | .000 | 1.48747 | .07740 | 1.33317 | 1.64177 |
| | Equal variances not assumed | | | 18.896 | 50.197 | .000 | 1.48747 | .07872 | 1.32937 | 1.64557 |

The group statistics table revealed that high performing school teachers are often committed as shown by a mean of 3.8684 while the low performing schools are rarely committed as shown by a mean of 2.381. The t-test yielded a t-value of 18.896 with a *p*-value of 0.00 which implies that the null hypothesis was rejected indicating that there is a significant difference between the self-evaluation ratings of mathematics teachers of high and low performing schools in teacher commitment. The mathematics teachers in high performing schools are often committed than their colleagues from low performing schools.

### *Comparison on Teacher Preparation*

Table 8 shows the mean comparison (group statistics and independent samples t-test) on teacher preparations based on teachers' self-rating.

Table 8: *T-test on Teacher Preparation*

**Group Statistics (Teachers' Ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Teacher Preparation | High-performing | 38 | 3.8070 | .27544 | .04468 |
| | Low-performing | 36 | 1.6389 | .61914 | .10319 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Teacher Preparation | Equal variances assumed | 22.780 | .000 | 19.638 | 72 | .000 | 2.16813 | .11040 | 1.94804 | 2.38821 |
| | Equal variances not assumed | | | 19.281 | 47.767 | .000 | 2.16813 | .11245 | 1.94201 | 2.39425 |

It is noted that teachers from high performing schools often prepared before going to teach than teachers in low performing schools as supported by a mean of 3.8070 and 1.6389, respectively. The t-test yielded a t-value of 19.281 with a *p*-value of 0.00, which implies that we reject the null hypothesis and say that there was a significant difference between the self-evaluation ratings of mathematics teachers of high and low performing schools on teacher preparation. This finding is supported by Armstrong et al. (2009) who wrote that in order to provide quality learning experience for all students, lessons must be well prepared and planned effectively. He wrote that the 21st century teacher has to specify his objective for the lesson well, conduct task analysis and match instructions to learners' characteristics. Indimuli et al. (2009) also agrees that teacher preparation is vital for effective teaching and learning process. Effective teaching involves preparation, implementation and evaluation of lessons (Indimuli et al., 2009).

***Comparison on Assessment/Evaluation***

Table 9 shows the comparison of means on evaluation and assessment based on teachers' self-rating.

Table 9: *T-test on Evaluation and Assessment*

**Group Statistics (Teachers' Ratings)**

| | Category | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Assessment and Evaluation | High-performing | 38 | 3.7368 | .18072 | .02932 |
| | Low-performing | 36 | 1.9667 | .33295 | .05549 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Assessment and Evaluation | Equal variances assumed | 15.752 | .000 | 28.630 | 72 | .000 | 1.77018 | .06183 | 1.64692 | 1.89343 |
| | Equal variances not assumed | | | 28.205 | 53.334 | .000 | 1.77018 | .06276 | 1.64431 | 1.89604 |

The group statistics table reveals that high performing school teachers often used assessment and evaluation as shown by a mean of 3.7368 while the low performing schools rarely used assessment and evaluation as shown by a mean of 1.9667. The t-test yielded a t-value of 28.205 with a *p*-value of 0.00 which implies that we reject the null hypothesis and conclude that there was a significant difference between the self-evaluation of mathematics teachers of high and low performing schools on assessment and evaluation. The mathematics teachers in high performing schools often use assessment and evaluation than their colleagues from low performing schools. Accurate assessment of students' academic abilities has been identified as one of the most crucial variables related to effective instructional planning and positive student outcome. Without a valid assessment of students' academic skills, instructional decision making is unlikely to promote academic (Shinn, 1998; Martens & Witt, 2004; Stiggins et al. 2007).

## CONCLUSIONS AND RECOMMENDATIONS

From this study, it was noted that mathematics teachers in Nandi-Central District public primary schools have a positive attitude toward mathematics. Mathematics performance in those schools where the teachers were committed to their duties, had positive attitude towards mathematics, prepare well before going to teach, used plenty of teaching relevant resources, and engaged their pupils through evaluation and assessment. The effectiveness of mathematics teachers should be enhanced in areas relating to teaching strategies such as use of clear questioning technique, creation of an effective climate for learning, planning for individual child's interests, being a reflective practitioner, encourage practical teaching in mathematics and inquiry learning styles.

On assessment and evaluation, mathematics teachers should be encouraged by Quality and Standards Office to make use of quizzes and tests to give pupils an opportunity to practice what they have learnt. Frequent exercises, assignments, home works and projects help to develop deep understanding of mathematics ideas and concepts. Teachers' commitment is vital in the teaching and learning of mathematics. All mathematics lessons have to be attended, punctuality in mathematics should be enhanced, and workbooks are promptly marked and returned to motivate pupils' interest in the subject.

The following points will be found useful by any mathematics teacher. First, learning to do mathematics in school, given the ways in which it is typically taught, may not equip even the successful student with adequate or appropriate knowledge of *or* about mathematics. Second, knowing mathematics for oneself may not be the same as knowing it in order to teach it. While tacit knowledge may serve one well personally, explicit understanding is necessary for teaching. Finally, subject matter knowledge does not exist separately in teaching, but shapes and is shaped by other

kinds of knowledge and beliefs. Further, some future research ought to link research on teacher preparation with teacher induction with professional development.

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