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Teachers' Attitude toward Mathematics Classroom Discourse in Secondary Schools in Vihiga County, Kenya.

Mwelese Jackson, Dr. Catherine Aurah, Dr. Martin Wanjala,
Doctoral Student of Mathematics Education.
Senior Lecturers, Department of Science and Mathematics Education.
Masinde Muliro University of Science and Technology

Abstract
This study was designed to investigate the teachers' attitude towards classroom discourse and how their attitude is associated with their classroom instructional practices. Their attitude was characterized by their conceptions about the nature of mathematics and their views about classroom discourse in the face of current reforms in mathematics. Mixed method research design was adopted. The study was based on theoretical frameworks of Vygotsky (1978) and Bruner (1986). The study was conducted in secondary schools in *Vihiga County,* Kenya. Proportionate stratified and simple random sampling techniques were used to select the sample. Data was collected using questionnaires, interview schedule and classroom observation checklist. Both descriptive and inferential statistics were used to analyze the data. The results of this study show that teachers in the control set ups tend to hold strong conceptions about mathematics that are consistent with the instrumental view. Their conceptions were not in line with the recommended reform approaches and have both desirable and undesirable consequences in the way teachers teach in the classroom. In view of the findings, it was recommended that in-order to gradually challenge the teachers' negative conceptions about mathematical classroom discourse, adequate educational interventions should be planned and implemented in teacher education programmes to support the teachers in concretizing these conceptions.

Key Words: Attitude, Classroom Discourse, Nature of Mathematics, Conceptions, Beliefs, Instruction, Interactions

Introduction

Mathematics is one of the compulsory subjects in secondary school curriculum in Kenya. The subject is highly regarded for placement in post secondary tertiary institutions like engineering, medicine, technology and commerce. Due to the overall importance in various aspects of life, mathematics is a basic requirement for the study of several other subjects in higher institutions of learning and even in several employment sectors. As a result, there is greater pressure for children to succeed in mathematics than in any other subjects in the school curriculum. Therefore mathematics being a service subject has some influence in future courses or employment opportunities of students. Poor performance in the subject implies that a large number of students are being examined for purposes of selection for further studies and employment opportunities where they may not excel.

In-spite of its importance, performance in mathematics has not been impressive. This has led to a general perception in some quarters that the teaching of mathematics at secondary school level has not to date made sufficient effort to deal with the backgrounds and needs of present day students. Despite the concerns raised and efforts made to improve results in mathematics, performance in the subject has continued to be poor over the years. The Kenya National Examinations Council (KNEC) Reports indicate that students have not been performing well in Mathematics over the years (KNEC Report, 2013; 2015; 2016; 2017). The Cabinet Secretary, Ministry of Education, in her speech to stakeholders on the management of national examinations, decried the poor performance in 2017 KCSE. She attributed this to poor grades in mathematics that has since had a negative effect on admission of students to teacher training colleges. Most colleges had reported very low enrolment in teacher training colleges.

A growing body of research provides convincing evidence that teacher's knowledge and belief about mathematics is closely linked to their instructional decisions and actions (NCTM, 1999; Thompson, 1992). This is supported by Stein & Carnine (1990) who state that teachers' ideas about mathematics, mathematics teaching, and mathematics learning, directly influence their notions about what to teach and how to teach it. Equally Schoenfeld (1985) observes that:

> *Belief systems are ones mathematical world view, the perspective with which one approaches mathematics and mathematical tasks. One's beliefs about mathematics can determine how one chooses to approach a problem, which techniques will be used or avoided, how long and how hard one will work on it and so on. Beliefs establish the context within which resources, heuristics and control operate.*

The statements above show that one's mathematical worldview may be closely linked to the person's actions and that teacher's goal for instruction are, to a large extent, a reflection of what they think is important in mathematics and how they think students' best learn. Their views and notions about students' classroom interaction and independence inform much of the teaching approaches mathematics teachers adopt.

Research has shown that difficulties concerning the implementation of innovations in the classroom are related to the resistant nature of teachers' beliefs (Nespor, 1987; Nisbett & Ross, 1980). In addition, studies have shown that older beliefs are the most resistant to change because, when they are tested, individuals tend to recall information however conflicting in a way that will sustain their own beliefs (Pajares, 1992). In the current reform movement in mathematics education, such teachers find it difficult to embrace alternative approaches that project the learner as one responsible to his/her learning. Instead, they stick to the conventional approaches that position them as the dispensers of knowledge as learners take the back seat.

Thus because the opportunity for changing their conceptions is essential for teachers' development and learner interdependence, it is important to understand not only what teachers believe but also how their conceptions are structured, held and relate to their instruction of mathematics in class. Influencing teachers' beliefs, therefore, is essential to changing their classroom practices. The focus of the study with regard to teacher's conception can be identified towards the assumption that teachers, who hold more learner centred, constructivist oriented conceptions, would adopt classroom practices that create greater enthusiasm toward whole class discourse that enhances problem solving activities. They will also actively engage their learners in construction of mathematical concepts, information sharing and developing mathematical thinkers and problem solvers.

It has been argued that most curriculum reforms advocate the constructivist views of mathematics and its teaching and learning (Smith 1996) which are substantially different from those underpinning traditional curricula. Therefore contemporary teachers are called upon to change their beliefs for the success of curriculum reforms. The importance of teachers' beliefs particularly mathematical beliefs to educational innovation has been increasingly emphasized by researchers (Battista, 1994; Handal & Herrington, 2003). Handal and Herrington (2003) observe that teachers' mathematical beliefs are critical in determining the pace of curriculum reforms. Mathematics teachers' beliefs can play either a facilitating or an inhibiting role in translating guidelines into daily reality of classroom teaching. Therefore if teachers hold beliefs which are compatible with innovations, then acceptance is more likely to occur. However if teachers hold opposing beliefs or perceive barriers in enacting the curriculum, then low-take up, dilution and corruption of the reform will likely follow. In this case, students will remain unengaged in class as the teacher dominates classroom activities into a monologue classroom experience.

The reluctance or the slow pace of teachers to implement the recommended approaches to teaching mathematics is linked by those advocating for change in mathematics instruction to the view that mathematics consists of a set of procedures and that teaching means telling students how to perform these procedures (Battista, 1994; p463). Thus the problem of teacher reluctance to embrace the new methodologies is seen to originate from a conflict between differing conceptions of the nature of mathematics and actual teacher-classroom activities. This study was designed to investigate teachers' attitudes towards classroom discourse and how these attitudes are associated with their instructional practices.

Purpose and Objectives of the study

The purpose of the study was to investigate the influence of teacher related factors in dialogic instruction and its promotion of mathematics classroom in secondary schools. The key teacher related factors were attitude and engagement of students in discourse. This paper therefore specifically presents an investigation into teachers' attitude towards classroom discourse and how their attitude is associated with their classroom instructional practices. Specifically, it sought to:

Establish the teacher's attitude towards dialogic instruction in mathematics.

Research Questions

In order to address the above objective, the following research questions were formulated:

1. What are secondary school mathematics teachers' conceptions about the nature of mathematics?
2. Is there a relationship between teachers' conceptions about the nature of mathematics and their actual classroom practices?
3. Is there a relationship between teachers' attitude about classroom discourse and their actual classroom practices?

Theoretical Considerations

The study draws on the socio-constructivist theory of learning by Bruner (Cobb, 1994; Cobb, Wood & Yackel, 1992) and influence of beliefs on practice by Anderson (1996). From a socio-constructivist perspective, a learning environment can be created where students construct their mathematical knowledge through interactive inquiry-based activities. Several key components are important for inquiry-based learning. These are exploring, conjecturing, generalizing and communication. The exploring process can promote students' inquiry and investigation of the task while the conjecturing and generalizing processes provide a means for students to construct their own mathematical knowledge. The communication process helps build meaning and permanence for ideas (NCTM, 2000). The socio-constructivist perspective emphasizes the role of others in constructing understanding. Socio-constructivist theories call for students to co-construct their knowledge through collaboration with their peers on meaningful activities. Dialogue and collaboration are seen as key to learning success. The social context constructed in the course of their interaction helps to enhance the students' thinking and learning in the classroom. Students' active participation and decision-making in the daily life of the classroom and school build responsibility and ownership for learning. These, in turn, become intrinsic motivators for further learning and resiliency.

The teacher's role from a socio-constructivist perspective is that of a facilitator to students' learning. He guides and supports their construction of viable mathematical ideas. According to Bruner (1986), the constructivist teacher by offering appropriate tasks and opportunities for dialogue, guides the focus of students' attention, thus unobtrusively directing their learning. The teacher influences learning through his attitude towards his practice and the level of engagement of his students in the learning process. A teacher teaching from a constructivist perspective must have the ability to pose tasks that bring about appropriate conceptual reorganizations in students' thinking. Here, his attitude shapes the learners' interest in learning. Such a teacher must also be skilled in structuring the intellectual and social climate of the classroom so that students discuss, reflect on, and make sense of these tasks. His level of engagement therefore brings on board the learners' interest and participation for meaningful learning.

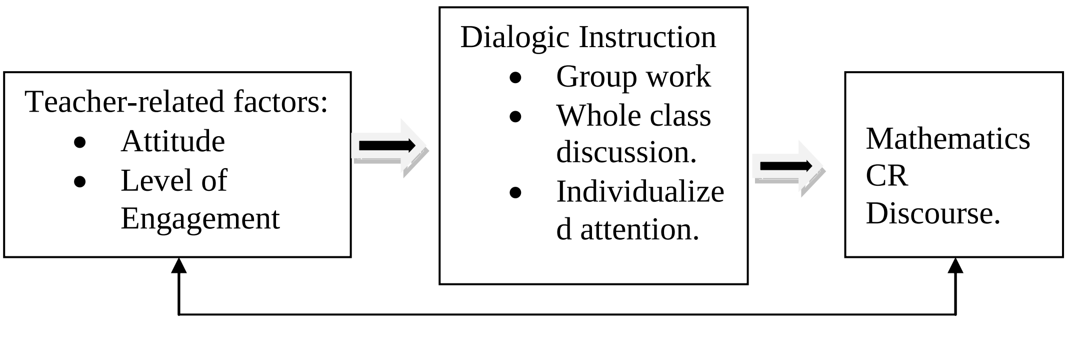

Figure 1: A Three-Tier Effect on Mathematics Classroom Discourse.
Source: Mwelese, J. (2018)

Figure 1 shows how the teacher related factors of attitude and levels of engagement affect the dialogic instruction that eventually affects the nature of mathematics classroom discourse. Positive attitudes and high learner engagement through group work, whole class discussion and individualized attention enhances meaningful learning. The socio-constructivist perspective provided a theoretical vantage for this study since the teacher's attitude of the relevance and usefulness of dialogic instruction not only dictates their use but also their roles and the impact of the method on learning discourse and achievement in mathematics.

According to Anderson (1996), teachers' reported beliefs are influenced by their actual beliefs (Thompson 1992), by their knowledge and interpretation of advice about teaching problem solving (Fennema, Carpenter and Peterson, 1989), by their use and understanding of curriculum document (Morine- Dershmer & Corrigan 1996) and by their own experiences in classrooms (Ball 1988). Reported classroom practices are influenced by reported beliefs, by actual practices in the classrooms as well as the constraints and opportunities that occur within school context (Tobin & Imworld 1993). Ernest (1989: p2) distinguished three possible conceptions of mathematics that relate significantly to a philosophy of mathematics.

> *First of all, there is the instrumentalist view that mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end. Thus mathematics is a set of unrelated but utilitarian rules and facts. Secondly, there is the Platonist view of mathematics as a static but unified body of certain knowledge. Mathematics is discovered not created. Thirdly, there is the problem solving view of mathematics as a dynamic continually expanding field of human creation and invention, a cultural product. Mathematics is a process of inquiry and coming to know, not a finished product, for its results remain open for revisions.*

Ernest (1989) further associated the views with corresponding models of teaching in the aspects of the teacher's role, the intended outcome of teaching and the teacher's use of curriculum materials. Table 1 shows a likely set of significant associations and implications of one's view about mathematics based on Ernest's model.

Table 1: Teachers' views about Mathematics and their implications based on Ernest's Model (p 2-4)

View of the Nature of Mathematics.	Teachers' Role	Intended Outcome of Instruction.	Use of Curricular Materials.	Learning Model.
Instrumentalist	Instructor	Skills mastery with correct performance.	Strict following of text or scheme.	Compliant behaviour and skills mastery
Platonist.	Explainer	Conceptual understanding with unified knowledge.	Modification of the textbook approach enriched with additional problems and activities.	Reception of knowledge model.
Problem-Solving	Facilitator	Confident problem posing and solving.	Teacher or school construction of the mathematics curriculum.	Active construction of understanding. Autonomous pursuit of own interests model.

As shown by Table 1, a teacher who follows the instrumentalist view of mathematics will tend to take an instructor's role in teaching where the main objective is for students to master the skills needed in mathematics. Teachers holding this view would strictly follow the prescribed text or scheme. It is also likely to be associated with the child's compliant behaviour and mastery of skills model of learning. The basis of knowledge here is rules, not necessarily concerned with understanding. There is an implicit belief that the curriculum and the corresponding instructional materials offer the best formula for mastering skills. Thus, instructions would tend to be very rigid.

Platonist view of mathematics is likely to be associated with the explainer model of teaching where learning is seen as the reception of knowledge. It is also likely to be associated with modification of textbook approach and enrichment with additional problems and activities. Teachers holding this view tend to lecture and explain concepts, focussing on mathematical content. They emphasise students' understanding of ideas and processes, particularly students' understanding of the logical relationships of mathematical concepts. The objective of instruction is for students to have a unified concept of mathematics and a consistency of ideas.

The problem-solving view of mathematics is the highest in the hierarchy and is a characteristic of dialogic classroom discourse. It is the recipe for group discussion and is associated with the facilitator model of teaching. This view encourages learning by active construction of one's knowledge and peer-to-peer interaction during solving of problems. The instructional objective of dialogic classroom discourse is to develop more confident (through peer interaction) and better problem-solvers (through sharing and justification of individual solutions). This view of mathematics encourages creativity and multiple approaches to learning a concept or skill.

Bernado (2002) describes two contrasting beliefs in Mathematics education as the School Mathematics Tradition (SMT) and the Inquiry Mathematics Tradition (IMT). The SMT involves classroom routines and discourses that are usually rigidly controlled by the teacher. This tradition emphasizes the formal presentation of mathematics as a collection of facts and procedures. Students are presumed to have learned when they can follow the procedures they were taught to obtain the correct answers.

In contrast, the IMT emphasizes more active learning on the part of the students, particularly by way of exploration, conjecturing, argumentation, proving, problem-posing, problem-solving and collaboration. In this tradition, the students are assumed to learn mathematics by resolving problematic situations that challenge their current understanding through classroom discourse. They engage in constructive and guided argumentation and sharing of their findings, justifying their solutions and allowing diverse ways to the solutions.

Shapiro (2000), Davis & Hersh (1991) generally agree on three conceptions of mathematics teaching and learning that influence teacher's practices. These were identified as Platonism (static view), formalism (mechanistic view) and constructivism (contemporary view). Rule & Lassila (2003), Davis and Hersh (1991) concur that Platonist and formalism conceptions are not mutually exclusive and that there is a thin line that divides them in that they both employ transmission principles of teaching mathematics.

Classroom discourse serves as a support and anchor to problem solving view that is based on Inquiry Mathematics Tradition. It is referred to in this study as the constructivist view (non- traditional approach). This view has been described as representing a reformed classroom (Clarke, 1997). teachers holding this view believe that mathematics is a dynamic subject to be explored and investigated through an active classroom tradition where students are charged with the responsibility to engage and learn. Here, problems through classroom discourse can be the focus of learning mathematics. Classroom practices associated with this perspective usually involve more group work and the use of non-routine questions that promote mathematical thinking and the development of problem solving skills. In such a lesson the following elements would be observed; students' on-task conversation or discussion is at least equal to, if not greater than teacher talk, instruction occurs individually or in small groups, rather than being directed to an entire class by the teachers and further a variety of instructional materials are on hand to enable students to use them independently and in small groups. These two perspectives represent end- points of conceptions about mathematics with many teachers holding beliefs that may be situated somewhere between.

Methodology

The study was carried out in selected secondary schools in *Vihiga County*, Kenya. The study adopted a mixed method research design. The design attempts to determine the causes or consequences of differences that already exists between or among groups. It begins with noted differences between groups and then looking for possible causes for or consequences of this difference. It is thus functional for researchers seeking to establish relationships that have already occurred and that cannot be manipulated directly (Fraenkel & Wallen 2006). The target population of this study were two trained mathematics teachers in each of the 30 public single sex secondary schools in Vihiga County at the time of the study.

Sample Size and Sampling Procedure

In selecting the schools, stratified random sampling was used to select 2 strata of schools on the basis of categorization by the Minister of Education and gender as National, Extra County and County schools, and boys and girls schools respectively. Proportionate sampling technique was then used to select 26.09% (30) of the schools which participated in the study. This is in line with the recommendation of Kerlinger (1973) who observes that in descriptive research, a sample of between 10-20% of the population is often deemed adequate. In selecting the sample from each school, simple random sampling technique by way of lottery was employed to select two form 2 classes in each of the 30 schools for investigation. Twenty four schools were divided into two groups; control and treatment. These schools had not covered Surface Area in the form two classes. Two form two mathematics teachers, teaching mathematics in the selected form two classes formed part of the sample.

Data Collection and Analysis Procedures

Teachers' conceptions of the subject and the methods of instruction were examined through responses to the questionnaire and interviews on the nature of mathematics. Their views and opinions about learner independence to learn, class discussions were also obtained from interview schedules and questionnaires. Data generated by the questionnaires was coded at two levels; ordinal and nominal level. The data was analyzed using descriptive and inferential statistics. Descriptive statistics included frequencies, percentages and means. Inferential statistics were employed to determine the significant differences between the means and also to determine significant correlations between the variables. The Mann-Whitney Test for comparison of mean ranks was used, Pearson's Product Moment Correlation Coefficient (PPMCC) was also used to check for any significant correlation between each demographic variables and each type of views. In the study, the Mann-Whitney test for two independent samples was used to determine whether teachers tended towards one type of view more than the others or not. To determine whether sub-groups within each variable differ in the way they view mathematics a one way ANOVA test was performed.

Results

Secondary School Teachers' Conception about the Nature of Mathematics

The study sought to establish the conceptions of mathematics teachers about the nature of mathematics. To achieve this objective, the respondents were asked to rate on a scale of 1 to 5, their agreements with 11 statements on the nature of mathematics. The items in the Mathematics conception survey were classified according to instrumentalist and constructivist views of mathematics. For every item a weighted average was obtained based on the responses of all the 20 teachers. This was done in the control classrooms that were not exposed to the dialogic intervention.

The weighted averages showed that teachers believe in the following aspects of the nature of mathematics: That skills learnt in mathematics are beneficial in other subjects, that mathematics problems can be solved using different ways and that studying mathematics helps develop the ability to think creatively. The weighted averages show that majority of respondents seem to view mathematics from its utilization aspect whereby mathematics is important in daily life and therefore the constructivist view. The weighted averages also showed that teachers do not seem to believe in the following aspects of mathematics: that mathematics is made up of unrelated topics, that mathematics is a set of rules, formulas and procedures, that mathematics is a rigid and uncreative subject and that mathematics should be made optional and not compulsory. From the above, teachers conceptions were not consistent with the instrumental views, which gives pre-eminence to the fact that mathematics is a set of unrelated collection of facts and that mathematical knowledge is certain and absolute truth. It appears that teachers are undecided about the aspects; that new discoveries are not being made in Mathematics, that students can create and invent mathematics, that Mathematics allows for trial and error in solving problems and that Mathematics involves memorizing of facts and manipulation of numbers. Teachers were undecided about various aspects of the nature of mathematics, which reflect the constructivist views, i.e. that students can create and invent mathematics, and that mathematics allows for trial and error in solving problems. This shows that the respondents have both instrumental and constructivist view towards these aspects.

To determine whether teachers tend toward one type of view of mathematics more than the other, the mean, standard deviation, mean per item and mean rank for each of the two views were obtained. Table 2 summarizes the results as obtained from the teachers.

Table 2: Mean, Standard Deviation and Mean Rank of each type of view on the Nature of Mathematics.

Statistic	Instrumental Beliefs	Constructivist Beliefs	*p* - value
Highest score	5 x 6 = 30	5 x 5 = 25	
Mean	18.50	20.40	
SD	3.893	2.540	21.1 (*sig)
Mean/item	3.083	4.080	
Mean Rank	2.000	2.800	

*significant

Table 2 shows that the highest mean score per item was on constructivist beliefs (*mean/item = 4.08*) showing that the sampled teachers reported conceptions of the nature of mathematics consistent with constructivist beliefs.

To determine whether teachers tend significantly towards one type of view of the nature of Mathematics more than the other, the Mann-Whitney test was employed. Since n = 20 which is greater than 7, the sampling distribution is a close approximation of the sampling distribution of chi-square with $df = 3\text{-}2 = 1$. The calculated value was 21.1 which is greater than the table value of 5.991. This implies that in regard to the nature of Mathematics, teachers significantly tend to hold more strong conceptions consistent with the constructivist view (*mean rank = 2.8*) than with the instrumental view (*mean rank = 2.0*).

Teachers' Conceptions and Classroom Practice

The objective was to find out the relationship between teachers conceptions and observed classroom practices. The classroom practices were measured using an observational scale. Each teacher in the sampled schools was observed twice on two different occasions and the final classroom score obtained by adding the two scores for each teacher. The total score on the observation schedule was 85. Table 3 shows the mean and standard deviation of observation scores and scores on the conception items.

Table 3: Mean, Standard Deviation of Conceptions for Each Type of Beliefs and Observed Scores

Statistic	Observations score	Instrumental items	Constructivist items	Composite item
Highest score	85	40	65	105
Mean	39.1	29.3	19.9	49.2
SD	10.1	5.09	3.52	5.28
Mean/item	2.3	3.66	1.53	2.34

From Table 3, analysis of the observation scores for all respondents showed a mean score of 39.1 with a standard deviation of 10.1 and mean per item of 2.3. The results indicate that on the whole teacher practices in the control groups were consistent with the instrumental view (mean per item of 2.3), which is lower than the expected mean per item of 3.0. Classroom observation indicated that 65% of the respondents employed traditional methods to teaching. The teachers presented the facts to students in which students listened to the teacher and thereafter students were given computational practice exercises. While 10% employed an intermediate approach and only 25% was observed to employed creative and explorative approach.

The general finding of this study was that some constructivist teaching was observed in the control classrooms. This accounted for about 15% of all the teachers. In these classrooms teachers gave more time for exploration, discussion between students and explanation of solutions than teachers with instrumental view in the control groups. On the other hand, on comparison, teachers in the treatment groups did more of facilitation; guiding the students in their groups as they engage in the activities, correcting misconceptions and mistakes and allowed students to own their learning. 85% of the teachers in the control classrooms engaged the students in whole class teaching with the students doing much of listening, taking notes and writing questions. In the control classrooms, 75% of the lesson observed combined some elements of constructivist teaching. The rest embraced instrumental teaching view.

In the control classrooms, the teachers' scores on the constructivist items, instrumentalist items and classroom scores were then correlated using Pearson product moment correlation as shown in Table 4.

Table 4: Results of the Pearson's Correlation

Statistic	Observation Scores	Constructivist Scores	Instrumental scores	Composite Scores
Observation Scores	1	-0.149	0.184	0.077
Sig (2tail)	0.000	0.531	0.439	0.749
N	20	20	20	20
Constructivist Scores	-0.149	1	-0.285	0.395
Sig (2tail)	0.531	0.000	0.224	0.085
N	20	20	20	20
Instrumental Scores	0.184	-0.285	1	0.768
Sig (2tail)	0.439	0.224	0.000	0.000
N	20	20	20	20
Composite Score	0.077	0.395	0.768	1
Sig (2tail)	0.749	0.685	0.000	0.000
N	20	20	20	20

A comparison of scores from the composite conceptions and observation scores showed a low and positive correlation of r = 0.077, which was not significant. This indicates that on the whole, teachers' conceptions are not significantly related to their classroom practices.

A comparison of the scores on the constructivist items and classroom practice showed low and negative correlation r = $^{-}$ 0.149 which was not significant at 0.05 level. This implies that some teachers with constructivist beliefs were observed to employ traditional practices in the classroom. Comparison of scores in instrumental items and classroom practices showed a low correlation r = 0.184. This indicates that teachers who had strong instrumental conceptions were observed to employ traditional practices in their classrooms.
Table 5 illustrates the differences in classroom practices between a teacher with instrumental conceptions that define his attitude and strong constructivist conceptions.

Table 5: Differences in Practices of Teachers according to Conception

	Activities	Instrumental	Constructivist
1	Checking of Assignment	Correct answers were written on the board. Students were marking each others' work.	Students worked on problems on C/B and explained their solutions.
2	Review of previous lesson	Recall of definitions and formula	Students were asked to give real life examples. Teachers gave examples from real life experiences.
3	Concept development	Teacher explained procedure and thereafter solved sample examples and gave practice examples	Students given tasks to explore and understand concepts
4	Students questions	Teachers did not encourage students to ask questions.	Teacher encouraged students to challenge others view. Teacher encouraged students to ask questions.
5	Application of concepts	Activity was focussed on algorithm. Students were engaged in computations.	Students engaged in discussions and computations

6	Teachers approach during solving problems	Teacher encouraged students to follow set down procedures.	Teacher allowed students to spend more time and consult, among themselves. Students encouraged to explore variety of ways on how to solve problems.
7	Type of problems	More of routine exercises with limited application.	Application problem were given more emphasis
8	Problem posing by students	Not observed.	Not observed
9	Types of activity prepared for fixing skills	Emphasis was on execution of mathematical operations and computation with speed	Teacher explanations followed by justification of generalisation on concepts
10	Emphasis in the generalisation part	Students asked to recite the definition and/or the formula. Application of formula not due given attention.	Teacher asked student to give the application or the concept in real life situation. Teacher explained relationship of concepts
11	Assignment	Follow up work given from text book and past papers.	Follow up given from text book and past papers
12	Source of questions	Textbooks	Textbooks

Qualitative analysis was done to find out the differences in practices between two teachers, one having instrumental conceptions from a control classroom and another with constructivist conceptions from a treatment classroom. The teachers with instrumental conceptions tended to strongly avoid empowering their students in classroom discourse. They often ended up encouraging teacher-centred environments in class at the expense of the learners. The learners remained passive throughout the lesson and so did not engage each other in classroom discussion. The teacher with constructivist conception on the other hand developed environments that allowed students to share information, ask each other questions, critique their contributions, problem solve and own their learning with very limited reliance on the teacher.

Discussion of Findings

Conceptions of the Nature of Mathematics

The objective of this study was to establish the attitude of Mathematics teachers towards dialogic instruction in mathematics as characterised by their conceptions about the subject and how this affects classroom discourse. Data analysis and interpretation of the questionnaire and interview from the teachers revealed the following major findings under this objective: It revealed that teachers held different conceptions about the nature of mathematics which can be categorized as instrumental and constructivist. These conceptions directly or indirectly affect their overall attitude towards mathematics instruction. However, the analysis showed that a good number of teachers tend to hold more strong conceptions consistent with the constructivist view. Their practice is dependent on external factors like syllabus coverage, learner-entry behaviour and school traditions.

The results confirm the findings of Thompson (1985) who found that Mathematics teachers may possess constructivist beliefs. Barkatas-Tasos & Malone (2005) also reported that contemporary view (constructivist) was rated more highly among secondary school mathematics teachers than both dimensions of the traditional view (static and mechanistic dimensions). Vistro-Yu C.P (2001) also found that secondary school teachers tend to hold more strong beliefs consistent with the constructivist view.

However, the findings of this study are different from that of Seaman, Syzdlink, Szydlink & Bean (2005) who reported that majority of pre-service mathematics teachers described mathematics as a collection of rules and formulas (traditional view). Nisbet and Warren (2000) reported that in regard to beliefs about the nature of mathematics, primary teachers held limited views of mathematics and that their views were consistent with static and mechanistic view rather than the dynamic problem-driven view which sees mathematics as an ever expanding field of human creativity; a view more aligned with the constructivist.

Perkkila (2003) reported inconsistencies in the conceptions which teachers had and reported that majority of the teachers held beliefs that were between primarily contemporary (instrumental view) and primarily traditional (constructivist view). In this study, the teacher's constructivist conception of the nature of mathematics could be attributed to the fact that they have gone through many years of mathematics studies and have been exposed to mathematics at various levels. Furthermore, their training may have included an introduction and discussion on the nature and development of mathematics.

The fact that some teachers hold the instrumental view should be of concern to mathematics educators since the constructivist view of mathematics has been over-emphasized in curriculum documents and in literature. The instrumental view may have been received and developed during their training especially when the subject is taught as skill mastery emphasizing on correct procedures and performance.

Teachers' Conceptions and Classroom Practice

The results indicate that on the whole there was no significant correlation between conceptions and classroom practice. Comparison of the constructivist conceptions and classroom practice showed little correlation, while comparison of the scores on instrumentalist conceptions also showed a low correlation. This indicates that those teachers with instrumental conceptions were observed to employ traditional practices in their classrooms. For teachers with constructivist beliefs, there appeared to be inconsistencies between their beliefs and practices. While the teachers had constructivist conceptions, their instructional practice was still focussed on textbooks, rules and procedures. Teachers mainly followed the order and the instruction of the textbooks. The right answers were more important than solution procedures. These results are supported by several earlier studies. For example, Thompson (1985) and Raymond (1997) have documented inconsistencies between professed beliefs and observed practices with an implication that teachers were unaware of a conflict between them. Brown (2003) and Cooney (1985) also identified inconsistencies between relationships of beliefs and classroom actions and indicated that for majority of teachers there was no statistically significant relationship between their conceptions and their actual classroom practice.

However, the results are contrary to Calderhead, (1996) in M. Keren Karac and John, Thretfall who established that teachers' beliefs about Mathematics teaching and learning have a significance influence on their instructional practices. Thompson, (1985) also found that teachers' beliefs were consistent with classroom practice. Brand (2004) and Ball (1998) also found that teacher's beliefs have a considerable effect on the nature of their classroom practices. Xenofontos (2007) in D. Kuchemann (ed) in a case study of three Cypriot primary teachers found that Ms. Electra's espoused beliefs were consistent with her classroom practice. Yates (2005) reported that teachers who scored highly on constructivism reported statistically significant more frequent use of child centred practices in their classroom.

Conclusions

The study examined the attitude of mathematics teachers towards dialogic instruction as demonstrated by their conceptions about the nature of mathematics and classroom discourse. On the view held by the teachers about the nature of mathematics, the study findings indicate that most mathematics teachers hold a constructivist view.

Secondly, with regard to classroom practice, secondary school teachers seem to employ traditional practices associated with the teacher-centred methods rather than the child centred methods. Thirdly, with regard to conceptions and classroom practice, the results indicated that teachers holding instrumental conceptions were observed to employ instrumental practices.

Fourth the close relationship between beliefs, classroom practice and effective professional development, the topic of teacher attitude towards instructional methods, teaching, learning and problem-solving needs to be addressed in the planning of professional development opportunities if there is genuine desire to change and improve classroom practice and thereby enhance students' skills and understanding in Mathematics.

Successful curriculum change is more likely to occur when the curricular reform goals relating to teachers' practice take into account teachers' conceptions. Teachers are the ones who ultimately decide the fate of any education enterprise. Consequently, teachers' attitudes, feelings, perceptions must be recognised well before the launching of any innovation. Likely discrepancies between teacher's opinion and the ideas underpinning a curriculum innovation need to be identified, analysed and addressed.

The current trends in Mathematics education towards constructivist learning environment and assessment of learning based on desirable outcomes will only succeed if teachers' beliefs about these reforms are considered and confronted. Otherwise, teachers will maintain their hidden agendas in the privacy of their classrooms and the implementation process will result in a self deceiving public exercise of educational reform and a waste of energy and resource.

Recommendations

The results of this study are considered as an important contribution, especially as it provides baseline evidence to monitor circumstances surrounding the teaching and learning of Mathematics. On the basis of the findings of the study, the following recommendations are hereby suggested.

1. In-service training that should deliberately include opportunities for teacher-participant to reflect on their conceptions and practices.
2. Enhance the pre-service and in-service programmes that deal with philosophical aspects of Mathematics education so that prospective and current teachers are provided with opportunities to get exposed to the different traditions and philosophies underlying the teaching and learning of Mathematics.
3. Kenya Institute of Curriculum Development should be encouraged to develop appropriate instructional materials and activities that enhance classroom discourse and teacher facilitation.

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