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MATHEMATICS TEACHERS' CONCEPTIONS ABOUT PROBLEM SOLVING AND ITS INFLUENCE ON THEIR CLASSROOM PRACTICES IN SECONDARY SCHOOLS IN KENYA

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Abstract:
The study investigated secondary school mathematics teachers' conceptions of problem solving and their classroom practices. The study was based on theoretical frameworks represented by Anderson (1996), Ernest (1991) and Bernardo (2002). The study was conducted in selected secondary schools in Uasin Gishu County, Kenya. Simple random and stratified sampling techniques were used to select 20 teachers from twenty schools. Data was collected using questionnaires, interview schedule and classroom observation checklist. Both descriptive and inferential statistics were used to analyze the data. In general, the results of this study indicated that there was no significant correlation between teachers' conceptions about problem solving and their classroom practice. The results of this study also showed that teachers tend to hold strong conceptions about problem solving that are consistent with the instrumental view. In view of the findings, it was recommended that in-order to gradually challenge the teachers' negative conceptions about mathematical problem-solving, adequate educational interventions should be planned and implemented in teacher education programmes and that teacher educators should assist and support teachers in concretizing these conceptions by undertaking reforms at both the pre-service and in-service training levels.

Keywords: teachers' conceptions, problem solving, classroom practices

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1. Introduction

Mathematics is an important subject and its usefulness range from utility, social, aesthetic and communication. For many it is seen in terms of arithmetic skills which are needed for use in everyday life situations e.g. at home, office and the workshop. Others view mathematics as the foundation for further studies and the basis of scientific and modern technology. However, 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 for the period 2004-2014 indicate that students have not been performing well in Mathematics. Several studies and reports on the factors that affect achievement in mathematics in Kenya at secondary school level (Too, 1986; KNEC, 2004; Eshiwani, 1993; Mwangi, 1985; Kiragu, 1986; and Maundu, 1986) have identified possible causes of poor performance in secondary schools in Kenya; as qualification of teachers, time spent in lesson preparation, teaching methods, frequency of supervision, student and/or teachers' attitude towards mathematics, teaching experience, class size and lack of facilities among others.

Significant changes have been made in the mathematics school curriculum, allowing for the creation of more facilities and the launch of the INSET/SMASSE programmes with the hope of improving results in mathematics. Despite these endeavours, performance in Kenya Certificate of Secondary Education (KCSE) nationally has continued to be poor. Calls have been made by stakeholders for change in mathematics curricula and pedagogy with government policies reflecting this thinking. However, many secondary school teachers do not endorse the instructional strategies recommended (Weiss, 1994). Most of them have been noted to prefer traditional methods by which they were themselves taught (Connel, 1987)

Approaches and nature of classroom teaching are reported from time immemorial as being quite similar in all countries over the world (Anderson, 1987) the nature of classroom teaching is quite similar in all countries,this is affirmed by Caar (cited in Kafu, 1976). Several studies conducted in Kenya have indicated the continued use of the traditional method among secondary school Mathematics teachers (Too, 1986; Kiragu 1986; O'Connor, Kanja and Baba, 2000). For instance, Too (1986) in a study of the availability and use of instructional media in Kenya found that the traditional/conventional methods were dominant in most mathematics classrooms. Similarly, O'Connor, Kanja and Baba (eds) (2000) in a survey of SMASSE project reported that whole-class instruction was the dominant approach used by most mathematics teachers in Kenyan secondary school classrooms. They also found out that the main role of the teacher is to dispense knowledge according to traditional form of prescription.

This picture of Mathematics teaching and learning portrayed above contrasts with the recommended methods in mathematics education. Here problem solving is presented as a major theme for the curriculum. This view of the importance of problem solving in mathematics education is parallel with the opinion put forward by several mathematics educators (Lester, 1977; Begle, 1979; Cockroft, 1982). Begle (1979) for example is of the opinion that the core of teaching mathematics is problem solving. Official reports such as NCTM (1980), Agenda for Action and the Cockroft Report (1982) recommends the adoption of problem solving approach to the teaching and learning of mathematics.

Problem solving view (Ernest, 1991), also viewed as Inquiry Mathematics Tradition (Bernado, 2002) is a constructivist view (non-traditional approach) that represents a reformed classroom (Clarke, 1997). Teachers subscribing to this view believe that mathematics is a dynamic subject to be explored and investigated. This view may be accompanied by a belief that problem solving is a means (Wright, 1992) and that problems can be the focus of learning in mathematical lessons. 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.

Anderson (1997) outlines the relationship and factors which influence teachers' problem solving beliefs/classroom. His model suggests that there is a complex relationship between mathematical teachers' beliefs and their practices in the classroom.It suggests that many factors influence teachers' problem solving beliefs and their practices. It further suggests that the manifestation of teachers' beliefs in the classroom would likely be influenced by (i) teachers prior experience in learning mathematics, (ii) teachers' experience in classroom teaching, (iii) teacher education programmes, (iv) understanding of curriculum document, (v) peer interactions, (vi) the school context.

The implementation of problem solving approach however depends to a large extent on individual teachers changing their conception toward mathematics and problem solving. Teaching reform cannot take place unless teachers deeply held conceptions about mathematics and its teaching change. Evidence indicates that a teacher's conception about problem-solving and its teaching rarely change without significant intervention. A shift to problem solving approach to teaching therefore requires a stronger assault on the prevailing beliefs and conceptions and hence the need for the reported study.

2. Purpose and Objectives

The sought to determine the relationship between teachers' conceptions about the nature of problem solving and their classroom practices. Specifically, it sought to:

1) Determine how secondary school mathematics teachers conceive problem solving in mathematics instruction.
2) Establishing the extent to which mathematics teachers employ problem solving in their classrooms.
3) Find out the influence of specific teacher characteristics on classroom practices.

3. Methodology

The study adopted the ex-post facto research design and was carried out in selected secondary schools in Uasin Gishu County in Kenya. The design was preferred in an attempt 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 study targeted all trained mathematics teachers in the secondary schools in the County. Proportionate sampling technique was then used to select twenty of the schools, representing a proportion of 30% toparticipate in the study. A total of 175 mathematics teachers took part in the study. Data for teachers' Conceptions about Problem-solving approach was obtained using a 32 item Secondary School Mathematics Teacher's Questionnaire (SSMTQ). In addition, teachers were interviewed. The questionnaire was favoured since it allowed for collection of data within a short period of time from a relatively literate population (Oso & Onen, 2005). In order to reduce on the limitations of the questionnaire, interview schedules were also used to add on what had been established from the quantitative data. The interviews enabled the teachers to elaborate their conceptions on mathematical problem solving. Cronbach's alpha was used to examine internal consistency of the tools and was found to be 0.74 showing that the tools were indeed consistent.

The data were 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 for the variables and each type of views. In the study, the Mann-Whitney test for two independent samples was used to determine whether teachers tend towards one type of view more than the other. To determine whether sub-groups within each variable differ in the way they view mathematics problem solving a one way ANOVA test was performed.

4. Results

4.1 Conceptions of problem solving in Mathematics

Weighted averages showed that teachers believed in the following aspects of mathematical problem; that mathematical problems are difficult word problems, mathematical problems arise from lack of basic skills and that mathematical problems can be solved by common sense and without using rules. The implication of these results is that mathematics teachers in Uasin Gishu County seem to hold constructivist views on the nature of Mathematical problem.

In relation to the role of problem-solving, weighted averages showed that teachers believe in the following aspects of the role of problem solving; that problem solving skills should be taught to high achievers, that students learn problem-solving by doing lots of exercises in mathematics, that problem solving skills should be taught in advanced courses, that students should be required to memorise procedures in order to solve problems, that students should be allowed to explore different methods of solving problems, that the most effective way to learn how to solve problem is by listening to teacher explanations, that problem solving is the application of computational skillsin mathematics, that the role of the teacher is to solve problems, and that mathematics problem can be solved in different ways, that application problems are best left at the end of the topic, that teachers should teach exact procedures for solving problems, and that teachers should use everyday life situation in the problem-solving of mathematics. Although the weighted average showed that some respondents believe that students should be allowed to explore different ways of solving problems and that problem can be solved in different ways they show that majority of the respondents seem to view problem solving as an end to itself. There is emphasis is on manipulations of numbers and operations, basic concepts and memorisation of basic facts. These views are associated with the instrumental view of problem solving.

The essence of these results is that whereas some teachers hold constructivist views of problem solving, most of them were undecided about various important aspects of problem solving which indicated that majority of the respondents seemed to hold both instrumental and constructivist views towards these aspects.From these results teachers seem to hold both the instrumental and constructivist views towards problem solving. For purposes of further analysis, the mean, standard deviation, mean rank and mean per item of teacher's scores for each of the two views were obtained (see Table 1).

The highest mean score per item was on instrumental conceptions (mean/item = 3.66) showing that the sampled teachers reported conceptions consistent with instrumental conceptions about the role of problem solving in the teaching and learning of mathematics. To determine whether teachers tend towards one type of view on the role of problem solving as compared to the other, the Mann-Whitney test was employed. The value from the test statistic was 24.947 at 2df which is greater than 5.991 (5% margin of error). This implies that teachers significantly tended to hold strong conceptions

consistent with instrumental view (mean rank 2.65) with regard to the role of problem-solving in mathematics.

Table 1: Mean, Standard Deviation and Mean Rank of Each Type of View on Problem Solving

	Instrumental Beliefs	Constructivist Belief	Composite Beliefs (Total)
Highest score	5 x 8 = 40	5 x 13 = 65	5x21=105
Mean	29.30	19.90	49.20
SD	5.06	3.52	5.28
Mean/Item	3.66	1.53	2.34
Mean Rank	2.65	1.15	

*P = value = 24.947df = 2.

4.2 Teachers' problem-solving activities in Mathematics classrooms

To investigate the extent to which mathematics teachers employ problem-solving in their classrooms teachers were observed using a classroom observation checklist. The observation addressed three main activities namely; types of problems used in mathematics lessons, types of problems solving strategies and types of teaching/learning activities used in mathematics lessons. All the teachers were observed twice on two different occasions and the final tally of the occurrence of the main events obtained by adding the two scores for each teacher.

4.2.1 Types of problem solving strategies

The study sought to establish how different problem solving strategies recur and vary in mathematics lessons. The items that explored the problem solving strategies used by teachers focussed on looking for patterns, making drawings/diagrams, constructing tables, and trial and error. Figure 1 lists the types of strategies and their frequency.

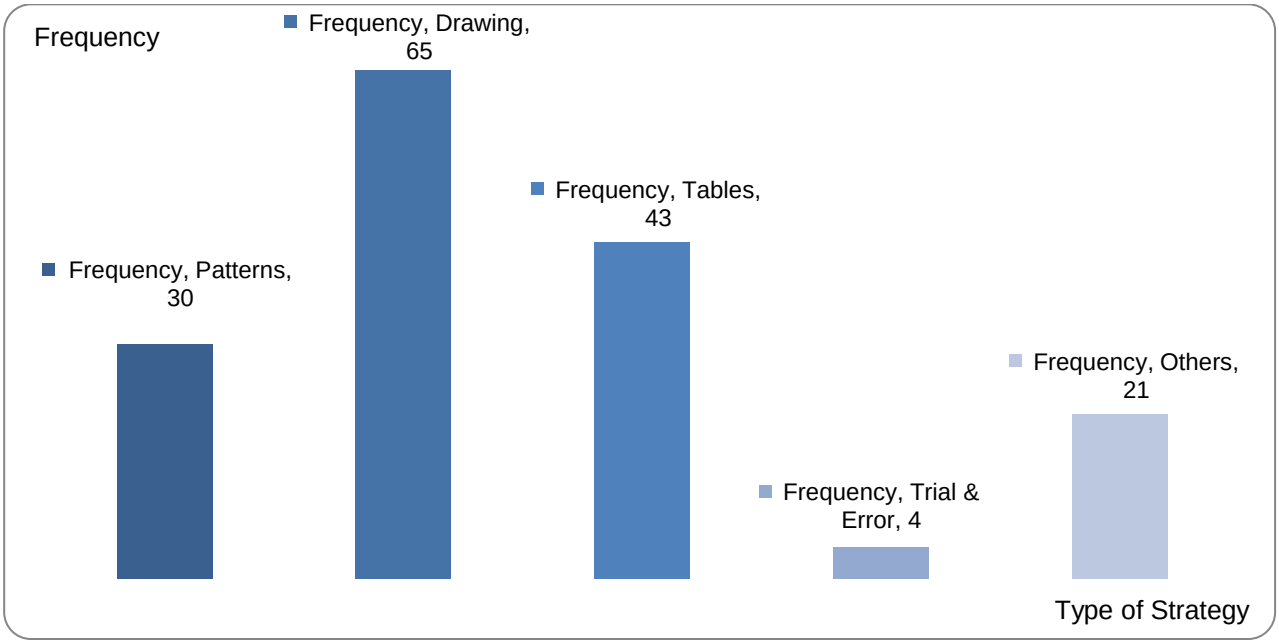

Figure 1: Frequency of Use of Types of Problem Solving Strategies

Making drawing and diagrams, followed by constructing of tables and looking for patterns were found to be the main strategies used.Although no one strategy could be described as best, trial and error strategy is used minimally in many in the mathematics classroom. The results show an over reliance on only three major strategies, which indicates that majority of teachers have limited knowledge on the role and benefits of strategies such as trial and error in solving problems.

Table 2 shows results of analysis of comparing types of strategies used across teacher gender, school category, and teaching experience. Twelve teachers of the expected 175 teachers declined to respond to these items.

Table 2: Teacher Characteristic and Type of Strategies Cross Tabulation

Types of Strategies		**Patterns**	**Drawing**	**Tables**	**Trial & error**	**Others**	**Total**
Gender	Male	20	41	26	2	14	103
	Female	10	24	17	2	7	60
School Category	District	20	40	25	3	14	102
	Provincial	10	25	18	1	7	61
Teaching Experience	1-3 years	5	11	5	0	5	26
	4-7 years	7	18	10	0	6	41
	8-15 years	12	24	17	1	7	61
	Over 15 years	6	12	11	3	3	35

Results show that both male and female teachers frequently use drawings/diagrams, and construction of tables. Besides in both type of schools, teachers seem to rely on drawings, followed by constructing of tables and looking for patterns.However, differences exist in the amount of strategies employed by the teachers with different teaching experience.

To determine whether the differences were significant, a one-way ANOVA was employed. Table 3 shows the summary of ANOVA results.

Table 3: ANOVA Results for Gender and Type of Problem Solving Strategies

		Sum of Squares	**df**	**Mean square**	**F.**	**Sig.**
Gender	Between Groups	.031	1	.031	.021	.885
	Within Groups	234.681	161	1.458		
	Total	234.712	162			
School Category	Between Groups	.005	1	.005	.003	.954
	Within Groups	234.707	161	1.458		
	Total	234.712	162			
Teaching Experience	Between Groups	.403	3	.134	.091	.965
	Within Groups	234.309	159	1.474		
	Total	234.712	162			

Resultsshow no significant differences by genderF (1,161) = 0.021, $p>0.05$; school type F (1, 161) = 0.03, $p>0.05$; and teaching experience F (3,159) = 0.91 $p>0.05$. Consequently, problem solving strategies used in mathematics classroom are independent of teachers' gender, school type and teaching experience.

4.2.2 Types of Problems Used in Mathematics Lessons

Results of types problems commonly used in mathematics instruction are shown in Figure 2.

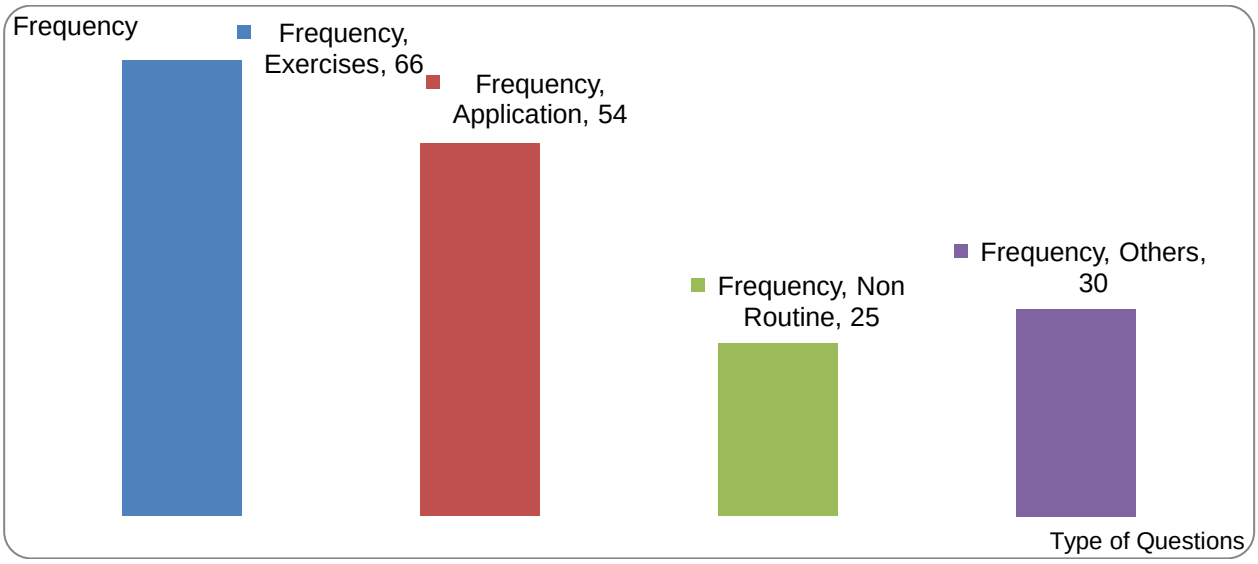

Figure 2: Frequency of use of each type of questions

Most frequently used type of problems by teachers were found to be routine exercises (37.7%), followed by application problems (30.9%) while the least used type of problems were others (17.1%) and unfamiliar problems (non-routine) (14.1%).

Results further revealed that were more routine exercises with limited applications, however some teachers were observed to give more emphasis to application problems. However, non- routine problems were found to still lag behind many others in the mathematics classroom.This implies that majority of teachers generally provide practice exercises on content which has been taught and therefore learners are not given opportunity to explore beyond the usual patterns and operations.

Comparison of use of particular types of problems across gender, school category, and teaching experience yielded results shown in Table 4.

Table 4: Teacher Characteristic and Type of Problems Cross Tabulation

		Mean	Exercises	Application	Non-routine	Others	Total
Gender	Male	8.85	45	34	16	20	115
	Female	8.57	21	20	9	10	60
	Total		66	54	25	30	175
School Category	District	7.92	41	18	31	13	103
	Provincial	10.28	25	12	23	12	72
	Total		66	30	54	25	175
Teaching Experience	1-3 years		18	9	12	6	45
	4-7 years		20	8	18	8	54
	8-15 years		19	8	17	7	51
	Over 15 years		9	5	7	4	25
	Total		66	30	54	25	175

Results reveal that male teachers gave a total of 115 problems distributed as follows 39.1% percent of these were routine exercise, 29.6% application questions, 17.4% others, while 14.1% non-routine (unfamiliar) question. The female teachers used a total of 60 problems of which 35% were routine exercises, 33.3% were application and 16.7% others and 15% non-routine (unfamiliar questions). Mean number of problems for male teachers was 8.85 and that for female teachers 8.57. The results show that there were more problems in district schools than in provincial schools. However, the mean number of problems in the district schools was 7.92 while that of provincial schools was 10.28. This indicates that individual teachers in provincial schools tend to give more problems to students than teachers in district schools. The results show that teachers with between 4 to 7 years of teaching experience tended to pose more problems than the other categories. A look at the mean number of problems per teacher indicates that teachers with (1 to 3 and 4 to 7) years have a higher mean than those in 8-15 years and over 15 years of teaching experience.

To determine whether there was a significant difference in the number and type of problems used according to teachers' gender, school category and teaching experience, a one-way ANOVA was employed. Table 5 shows the summary of the results.

Table 5: ANOVA Results for Teacher Characteristics and Types of Problems

		Sum of squares	df	Mean square	F	Sig.
Gender	Between Groups	.400	1	.400	.327	.568
	Within Groups	211.349	173	1.222		
	Total	211.749	174			
School Category	Between Groups	.442	3	.147	.119	.949
	Within Groups	211.307	171	1.236		
	Total	211.749	174			
Teaching Experience	Between Groups	.956	1	.956	.785	.377
	Within Groups	210.792	173	1.218		
	Total	211.749	174			

Results show lack of significant differences by gender F (1, 173) = 0.327, p>0.05; School type F (1,173) = 0.785, p>0.05 and teaching experience F (3,171) = 0.119, p>0.05. Therefore, there are no major differences in the number and types of problems used according to gender, school type and within the different category of teaching experiences. However, an examination of the data indicates that male teachers tend to give more problems of the three types than female teachers.A close scrutiny of the data obtained also indicates that in all the cases exercises and application problems are more predominant as compared to unfamiliar (non-routine) problems.

4.2.3 Classroom Activities in Mathematics Lessons

Figure 3 shows the six types of classroom activities commonly employed by the teachers.

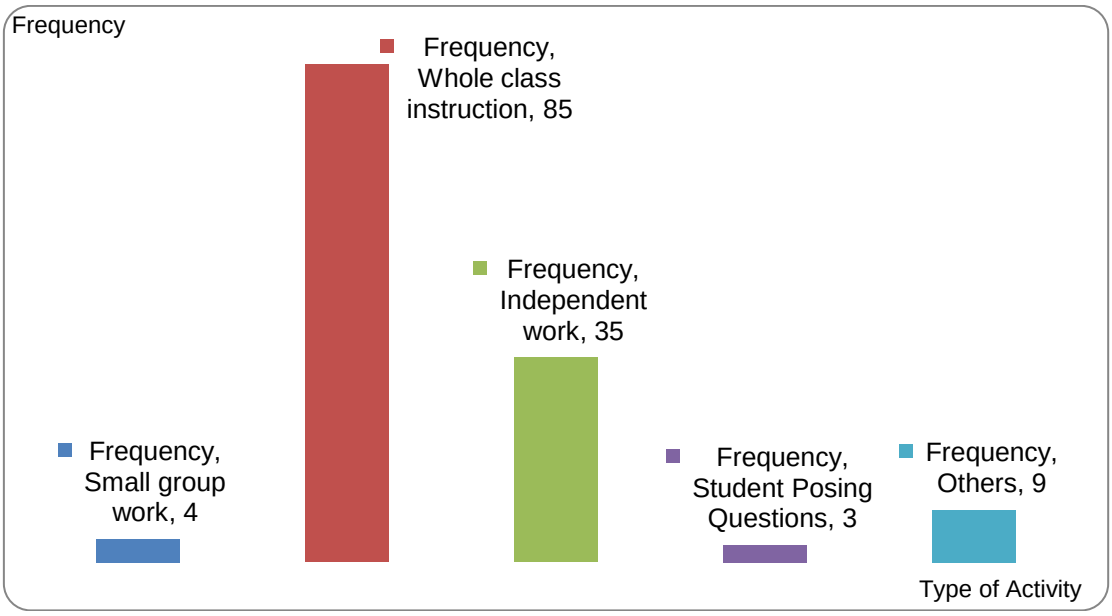

Figure 3: Frequency of use of each type of Activity

Results reveal that independent work by students; students posing own questions; and small group work were infrequently used by teachers. Teachers seemed to rely more on whole class instructions. Majority of teachers dominated class activities through explanations and overemphasis on the formal presentation of Mathematics as a collection of facts and procedures and students' algorithm. Teacher centred activities were therefore predominant. The findings indicate that problem solving strategies were not getting the required attention.

Analysis concerning the types of teaching activities based on gender, school category and teaching experience was carried out and the results are indicated in Table 6.

Table 6: Teacher Characteristic and Type of Teaching Activities

		Mean	Whole class instruction	Small Group Work	Independent work	Problem posing	Others
Gender	Male	6.9	61	2	19	2	6
	Female	6.7	25	3	14	2	3
School Category	District	6.9	56	4	22	2	6
	Provincial	6.7	30	1	11	2	3
Teaching Experience	1-3 years	5.8	20	0	7	1	1
	4-7 years	6.8	24	2	11	1	3
	8-15 years	8	28	3	11	2	4
	Over 15 years	6.3	14	0	4	0	1

Mean number of activities for males were 6.9, while that for females were 6.7. Results further show that there were more teaching/learning activities in district schools than provincial schools. The mean number of activities for district schools were (6.9) and for provincial (6.7) which indicates that individual teachers in provincial schools tend to ask

the same number of questions with those in district schools. In addition, there were more teaching/learning activities among teachers with teaching experience of between 8-15 years with the mean number of activities of 9, as compared to those with 1-3 years (m=5.8), 4-7 years (m=6.8) and over 15 years (m=6.3).

To determine whether there is a significant difference in the numbers of type of activities according to gender, school category and within different teaching experience; a one-way ANOVA was employed. Table 7 presents the summary of the results.

Table 7: ANOVA Results for Type of Activities according to Teachers' Characteristics

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	7.530	1	7.530	1.978	.162.949
	Within Groups	513.973	135	3.805		
	Total	521.504	136			
School Category	Between Groups	.002	1	.002	.001	.982
	Within Groups	521.502	135	3.863		
	Total	521.504	136			
Teaching Experience	Between Groups	2.366	3	.789	.202	.895
	Within Groups	519.137	133	3.903		
	Total	521.504	136			

There were no significant differences by gender F (1, 135) = 1.978, p>0.05; school type F (1, 135) = 0.01, p>0.05; and teaching experience F (3, 133) = 0.202, p>0.05.Hence, number and type of teaching/learning activities are independent of teacher gender, school type and teaching experience.

4.3 Teacher Characteristics and their influence on Classroom Practice

To establish the influence of specific teacher characteristics classroom practice, teachers were observed, and scores recorded using a classroom observation rating scale. The results are as shown in Table 8 below.

Table 8: Mean and Standard deviation of scores
by gender, school category and teaching experience

Characteristic		N	Mean	SD	Mean/item
Gender	Male	13	38.31	10.43	2.35
	Female	7	40.57	10.13	2.39
Type of school	District	14	35.93	10.19	2.11
	Provincial	6	46.50	5.01	2.73
Teaching Experience	1 to 3yrs	4	43.50	9.88	2.56
	4 to 7 yrs	7	36.85	10.24	2.17
	8 to 15 yrs	6	38.83	10.68	2.28
	Over 15 yrs	3	39.00	13.00	2.29

Gender mean differentials indicated that female teachers have higher mean scores in regard to their observed practice. The mean per item for both male and female teachers were below 3, which indicated that their practice lean towards instrumental or traditional

practice. Further, mean differentials indicated that teachers in provincial schools had higher mean scores in regard to their observed practice. The mean per item for teachers in provincial schools was 2.73 surpassing the overall mean per item of 2.3. This indicates that teachers in provincial schools tend to engage in activities consistent with constructivist practice.

Mean differentials in teacher experience indicated that teachers who had taught for between 1 and 3 years had higher mean scores with regard to their observed practice. The mean per item for teachers in this category was 2.56 surpassing the overall mean per item of 2.3. This indicates that teachers who had taught for 1 and 3years seem to engage in activities consistent with constructivist practice. However, in general the mean per item for all teachers were less than the expected mean per item of 3, which indicated that their practice tends to lean towards instrumental or traditional practice.

Analysis of the influence of teachers' gender, school type and teaching experience on their classroom practice revealed results presented in Table 9.

Table 9: ANOVA Results for Teachers' Characteristics and Classroom Practice

Characteristic	**ANOVA Source**					
	SS		**Df**	**MS**	**F**	**Sig.**
Gender	Between Groups	23.316	1	23.316	0.219	0.646
	Within Groups	1920.484	18	106.694		
	Total	1943.8	19			
Type of school	Between Groups	469.371	1	469.371	5.730	0.028*
	Within Groups	1474.429	18	81.913		
	Total	1943.8	19			
Teaching Experience	Between groups	113.11	3	37.703	.330	.804
	Within Groups	1830.690	16	114.418		
	Total	1943.8	19			

Teacher gender {F(1,18)=0.219, p>0.05)} and teaching experience {F(3,16)=0.330, p>0.05)} had no significant influence on classroom practices. However type of schoolwas found to have a significant influence on classroom practices {F(1,18)=5.730, p<0.05)}.

5. Discussions

5.1 Teachers' Conceptions about Problem Solving

The study revealed that a number of teachers believe that problem-solving skills should be taught to high achievers only, that problem-solving requires following step by step procedures and that they consider solving problems as the mastery and application of computational skills. Further, a majority of teachers believe that problem solving is an added topic in the curriculum and that students are able to solve problems after they have acquired basic skills and procedures. The results revealed that mathematics teachers hold different conceptions of problem-solving. Most of them hold strong conceptions consistent with the instrumental view as opposed to constructivists view.

These results confirm findings by Kayan and Cakiroglu (2007) that teachers view problem solving as an activity for practicing an introduced concept or algorithm in mathematics. These results are also consistent with findings by Brosnan and Erickson (1996) that teachers give more importance to student's answers rather than their problem solving solutions.

However, the results are in contrast to a number of studies which indicate that teachers hold constructivist beliefs about mathematical problem solving.For instance Brown (2003) found that teachers highly support the idea that students should spend time on problems and try to understand why a solution works. Futch, Stephens and James (1977) reported that teachers believed that problem solving should be integrated into the entire Mathematics curriculum. These contradictions require that in order to gradually challenge the teachers' instrumental conceptions about mathematical problem solving, adequate interventions be planned and implemented in teacher education programmes.

5.2 Teachers' Actual Classroom Practices

A majority of teachers were found to engage in activities consistent with instrumental practice and mostly follow the order and instructions of the textbooks.To them, right answers were more important than solution procedures. Their teaching practices were closer to the traditional practice than the constructivist practice. Besides, most of the teachers do not teach problem solving due to students' weaknesses, limited time and majorly because of examination requirements. This finding is similar to that of Too (1996) and O'connor, Kanja and Baja (2000) who found that the traditional/conventional methods were dominant in most Mathematics classrooms in Kenya.

Further analysis indicated that there were no significant differences in classroom activities with specific teacher characteristics. The results of this study support TIMSS Video study (Hollyworth, 2003) into year 8 Mathematics classroom which reported that there was little evidence of teachers using challenging problems.Kaur (2001) explored the reasons for the success of students from Singapore in both the Third International Mathematics and Science Studies (TIMSS) and TIMSS-R. She reported that in lessons, teachers place major emphasis on students solving non-routine problems.

Emphasis on student achievements in examinations possibly explains non-compliance with problem solving as required in the 8-4-4 mathematics curriculum. Lessons are mainly dominated by activities which involve solving non-routine problems similar to those expected in the examinations. The significance attached to national examinations will determine to a large extent how effectively problem-solving is taught in Kenyan secondary schools. This implies that majority of teachers neglect the problem-solving skills and thereby concentrate on the topics which are likely to be tested in the national examinations.

6. Conclusions

Public secondary schools mathematics teachers' conceptions of problem-solving are not in line with the new reform approaches. They are more aligned to instrumental view that sees them employ more instrumental practices. Planning for professional development opportunities could benefit greatly from the close relationship between beliefs, classroom practice and effective professional development. Successful curriculum change is therefore more likely to occur when the curricular reform goals relating to teachers practice take into account teachers' conceptions, given that they 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.

7. Recommendations

In-service training that deliberately includes opportunities for teacher-participant to reflect on their conceptions and practices should be frequently rolled out. This would ultimately expose teachers to learning materials and activities that are inclined to constructivist practice. Besides, there is need to increase the level of support for teachers through appropriate practical and hands on in-service training or workshop with demonstration of problem solving approaches. More importantly, teachers should be encouraged to integrate problem solving into daily Mathematics lessons and incorporate problem solving into the curriculum.

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