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The Impact of Teachers' Classroom Monitoring to Enhance Students Learning Mathematics in Secondary Schools in Tanzania

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Abstract

Classroom monitoring is one of the aspect of effective practices of formative assessment based on the way teachers' utilized classroom discussions, questions, and learning tasks that elicit evidence of teaching and learning. This study present findings conducted to explore the impact of teachers' classroom monitoring to enhance students learning mathematics in secondary schools in Tanzania. The study employed a mixed methods research approach and consisted of 59 respondents drawn from twelve private and public secondary schools in Arusha city and Kinondoni Municipality. Nonparametric methods such as Mann-Whitney U test and Kruskal-Wallis H test were used to analyze the quantitative data. The demographic characteristics which were analysed were sex, training status, school type, teachers' qualifications, teaching experience, number of periods and classroom size. Results indicates that female teachers appear to utilized classroom monitoring more effectively than their counter part male teachers. On the other hand, mathematics teachers in public schools appeared to be more effective in utilizing classroom monitoring than teachers in private schools. On the same vein experienced teacher appears to utilized classroom monitoring more effectively than less experienced teachers.

Keywords: Classroom monitoring, formative assessment, teaching and learning mathematics

The Concepts of Formative Assessment

Formative assessment is one of the most effective classroom interventions to support teaching and improve learning (Black & Wiliam, 1998a). It is a central aspect of classroom assessment that connects teaching and learning. Cowie and Bell emphasize that formative assessment is the process used by teachers and students to recognize and respond to student learning in order to enhance student learning, during the teaching and learning (Cowie & Bell, 1999). Furthermore, formative assessment is only formative if it leads to action on the part of the teacher to enhance student learning in some way (Bell & Cowie, 2001). The formative assessment strategies can range from "coordinating highly-effective classroom discussions and questions, providing more-specific feedback on students' papers, engaging students in critiquing their own learning and that of their peers" (Wei, 2010, p. 838). Formative assessment provides necessary information to teachers and students about progression of the lesson.

Wiliam (2005) identifies strategies for formative assessment as classroom monitoring, feedback, sharing learning criteria with learners, peer-assessment and self-assessment. This paper intends to discuss the monitoring of student learning as one aspect of formative assessment in teaching and learning mathematics in Tanzania. The strategy involves student questioning, classroom discussions and student activities

focuses on the teacher's ability to identify the level of student learning on an ongoing basis. Teachers guide the process by engaging learners in group activities, questioning or individual assignment. Oswalt (2013, p.25) contends that "breadth of techniques that can be used to monitor student learning through engineering effective classroom discussions, questions, and learning tasks is admittedly immense. One technique, however, is worthy of particular attention because of the manner in which it often infuse classroom instruction with questions".

When teachers use questions formatively, can help for eliciting information, probing students' ideas, capturing different types of knowledge, and prompting deeper levels of understanding (Ruiz-Primo, 2011). In the classroom, improving questioning techniques has a direct relationship with student interaction with instructional material and therefore, increased student learning and more informed teacher decision-making (Black, et al., 2002). It further provides students with meaningful direction with teacher comments on assignments.

Utilization of Formative Assessment in Africa Countries

Perry (2013) carried out a qualitative study to examine formative assessment practices currently being utilized in Africa as well as recent research regarding professional development on formative assessments. Perry suggested that teachers in Africa utilize informal strategies, such as questioning and monitoring students as they work, as well as formal strategies, such as assigning homework and administering tests, to gauge student learning and improve instruction.

On the other hand, teachers' lack of knowledge for formative assessment was also reported by Nakabugo (2003) that in Uganda many teachers in primary schools did not know what formative assessment was and how they should implement during their classroom practices due to lack of training. Arguing in favour of training on formative assessment Akom (2010), Kanjee (2009), Kapambwe (2010), Miske (2003) and Perry (2013) advocate for training teachers on the use of specific formative assessment tools has a positive impact on assessment in the classroom.

Literature indicated that formative assessment does not occur accidentally in classroom, it's a planned process. Popham (2008) observed that formative assessment is a planned process in which assessment-elicited evidence of students' status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics. The biggest challenge for the implementations of formative assessment is teachers' conceptions and beliefs about formative assessment. Literature indicated that teachers' conceptions and beliefs about formative assessment influence its implementation in teaching and learning (Ndalichako, 2015).

Strengthening Formative Assessment in Mathematics Classroom

While empirical studies acknowledge the role of formative assessment in students' academic achievement worldwide, the situation in Tanzania is different. Despite the fact that curriculum documents in Tanzania require and expect teachers to use "formative assessment in classrooms", its implementation is weak (Malaba, 2013; Ndalichako, 2015; Omar, 2011; Tilya, 2012). The ineffective practice of assessment in the classroom, especially formative assessment in secondary schools in Tanzania may be one of the factors that might have contributed to poor performance in mathematics subject in recent years. Table 1 shows the total number and percentage of students who passed and failed in Mathematics subjects for past seven years (2015 to 2021).

Table 1.1: CSEE candidates' performance in mathematics from 2015 to 2021

Year	Candidate sat for CSEE	Pass (A-D)	Fail (F)
2021	487,365	94,677 (19.43%)	392,688 (80.57%)
2020	435,345	87,582 (20.12%)	347,763 (79.88%)
2019	424,652	84,578 (19.92%)	340,074 (80.08%)
2018	360,225	71,703 (19.90%)	288,522 (80.09%)
2017	317,444	60,621(19.10%)	256,823 (80.90%)
2016	349,202	65,990 (18.90%)	283,212 (81.10%)
2015	383,851	64,332 (16.80%)	319,519 (83.20%)

Source: *NECTA examinations results statistics 2015-2021*

It is evident from Table 1 that, the number of students who obtained failure (F) grade has remained almost over 80% of all candidates sat for Certificate of Secondary Education Examination (CSEE) in Mathematics for the past seven years. This results indicate that students' performance in the (CSEE) results in mathematics has been poor for a long time now (Joshua, 2013; "National Examination Council of Tanzania" [NECTA], 2014; Kitta, 2004; Philemon, 2011). Several reasons for poor performance in mathematics have been advanced. These include demographic characteristics such as gender, age, location, unqualified and under-qualified teachers, inadequate teaching experience, low motivation, overloaded syllabus and classroom overcrowding (Joshua, 2013; Kitta, 2004; 1994; Mkumbo, 2013; Sangwa, 2011). On the same vein, Wayne and Youngs (2003) maintain that teachers' demographic characteristics are important for students' academic achievement. Therefore, as already noted, formative assessment holds positive projection and potential to improve the quality of students' learning and performance. It was such a background that compelled the researcher to undertake a study to investigate the impact of classroom monitoring to enhance teaching and learning mathematics in secondary schools in Tanzania.

Classroom Monitoring as Aspect of Formative Assessment

Classroom monitoring is one of the aspect of effective practices of formative assessment. Kanjee (2020) noted that classroom monitoring is relates to teachers' use of appropriate techniques, activities and questions to encourage all learners to participate in classroom activities as they obtain evidence of learning. Classroom monitoring are based on how teachers' utilized classroom discussions, questions, and learning tasks that elicit evidence of learning in teaching and learning mathematics in line with formative assessment.

Methodology and design

Results

The analysis was conducted based on teachers' demographic characteristics which were sex, training status, school type, teachers' qualifications, teaching experience, number of periods and classroom size. Table 1.2 presents Mann-Whitney U test for teachers' attributes with two variables such as sex differences, training status and school type on the influence of utilization of classroom monitoring in the teaching and learning of mathematics.

Table 1. 2: Mann-Whitney U Test on Utilization of Classroom Monitoring based on Sex Differences, Training Status and School Type

	Measures	N	Mean Rank	Sum of Ranks	Mann-Whitney U test	Critical value	p-value.
Sex	Male	25	15.56	389.00	64.00	80	0.011*
	Female	11	25.18	277.00			
In-service training	Attend	22	19.23	423.00	138.00	93	0.60
	Not attend	14	17.36	243.00			
School type	Public	18	23.28	419.00	76.00	99	0.006*
	Private	18	13.72	247.00			

Key: *N= number of respondents, df = degree of freedom * p-value is significant at 0.05 level (2-tailed)*

The data from Table 1.2 indicate that, female teachers obtained a mean rank = 25.18 and male teachers mean rank = 15.56 with critical value = 80 and p-value = 0.011, which was statistically significant at α = 0.05 level of confidence. This implies that, female teachers appeared to be utilizing classroom monitoring more effectively than their counter part male teachers. With respect to teachers' in-service training status, the *Mann-Whitney U test* revealed no statistical significant differences between teachers who attended and those who did not attended the in-service training. Regarding to the school types, the results indicate that public schools had the mean rank = 23.28 and private schools mean rank = 13.72 with critical value = 99 and p-value = 0.006 which were statistically significant at α = 0.05 level of confidence. This implies that, mathematics teachers in public schools appeared to be more effective in utilizing classroom monitoring than teachers in private schools. This might be due to the fact that, some of the teachers in private schools had not undergoing the teaching professional courses. Furthermore, an analysis was carried out to investigate other characteristics that could influence teachers' utilization of classroom monitoring. Table 1.3 presents the *Kruskal-Wallis H test*, for the attributes with three variables such as teachers' qualifications, teaching experience, number of periods and class size.

Table 1.3: Kruskal-Wallis H test on Utilization of Classroom Monitoring based on Selected Teachers' Demographic Attributes

Measures	Measures	N	Mean Rank	χ^2	df	p-value
Qualifications	Diploma	11	23.00	4.214	2	0.122
	Bachelor	21	17.55			
	Master	4	11.13			
Teaching experience	1-5years	15	12.80	6.100	2	0.013*
	6-10years	7	16.64			
	11+ years	14	22.32			
Number of Periods	Less than 20	13	18.04	0.976	2	0.614
	Between 20-30	14	17.07			
	30+	9	21.39			
Class Size	Below 40	3	14.83	1.816	2	0.403
	Between 40-50	13	16.15			
	50+	20	20.58			

Key: *N= number of respondents, df=degree of freedom, * p-value is significant at 0.05 level (2-tailed)*

The findings from Table 1.3 indicate that, the mean rank for diploma teachers = 23.00, bachelor degree holder = 17.55 and master = 11.13, with χ^2 = 4.214 and p-value = 0.122. This was not statistically significant at α = 0.05 level of confidence. These results suggest that, teachers' qualifications did not influence utilization of classroom monitoring. Further interpretation indicates that, diploma holders utilized classroom monitoring more effective than teachers' with degrees.

However, with regards to the teachers' teaching experience the findings displayed remarkable results whereby teachers with more than 11 years of working experience obtained the mean rank = 22.32 while less experienced teachers obtained mean rank = 12.80 and 16.64 respectively, with χ^2 = 6.100 and p-value = 0.013. This was statistically significant at α=0.05 level of confidence. This result implies that, teachers ability to utilized classroom monitoring grow with their teaching experience. In addition, the researcher carried out the multiple comparisons (Post-Hoc test) analysis to find out groups that were statistically significantly different in terms of teachers' teaching experience. Table 4.11 presents Mann-Whitney U test results for teachers teaching experience.

Table 1.4: Post-Hoc Test Using Mann-Whitney U Test on the Utilization of Classroom Monitoring Based on Teachers' Teaching Experience

Measures	N	Mean Rank	Sum of Ranks	Mann-Whitney U test	Critical value	p-value
1-5 years	15	11.27	169.00	49.000	24	0.801
6-10 years	7	12.00	84.00			
1-5 years	15	12.53	188.00	51.000	59	0.043*
11 +	14	17.64	247.00			
6-10 years	7	8.64	60.50	32.500	22	0.213
11+	14	12.18	170.50			

*Key: N= number of respondents, * p-value is significant at 0.05 level (2-tailed)*

The findings from Table 1.4 reveal that, teachers with 1-5 years of teaching experience obtained a mean rank = 12.53 and teacher with experience more than 11 years obtained mean rank =17.64, with critical value = 59 and p-value = 0.043 which statistically significant different at α=0.05 level of confidence. This finding implies, that an experienced teacher appears to utilized classroom monitoring more effectively than less experienced teachers. Further interpretation indicates that teachers with more than 11 years of teaching experience appeared to be more knowledgeable and skilled in utilizing classroom monitoring than less experienced teachers.

Long experienced teachers' utilized more frequently classroom monitoring than less experienced teachers in teaching and learning mathematics. Extract 1.1 presented example of classroom instructional activities which show a long experienced teacher T1 from school A3 utilizing classroom monitoring in line with formative assessment during mathematics lesson.

Extract 1. 1: Instructional Activities presented by Mathematics Teacher T1 from School A3 Showing Utilization of Classroom Monitoring

Topic: Matrices and transformations **Subtopic**: Transformation
Class: Form Four **Time:** 40 minutes
Specific Objective: The students should be able to use a matrix to rotate any point P(x, y) through 90^0, 180^0, 270^0 and 360^0 about the origin
Lesson progress:

Responsible	Teaching and Learning Activities	Remarks
Teacher	Introduced the lesson by using KWL i.e asked students what they know about transformations of point along x-y axis	Teacher uses various strategies such as questions and answers, pair and share to confirm participations of every student.
Students	Provide examples of transformation on x-y axis	
Teacher	Guide students to rotate point (x, y) through 90^0 and 180^0 using rotation matrix $T = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$	There is evidence that the teacher is monitoring student learning through moving from one group to another
Teacher	Provide class activity for the students to rotate point A(1,2) , B (3, 4), C(-1.3) and D(-2, -3)	Teacher continues moving around each group to monitor learners' progress.
Teacher	Provide opportunity for students to ask questions	Encourage students to respond to their peers questions.
Teacher	Move around to mark individual work within their groups	Teacher observes some difficulties students face in doing the class work
Teacher	Through question and answer technique teachers asked students questions on algebra (which was one of the noted difficult)	Teacher uses positive questioning techniques and give adequate wait time, open-ended on algebra problems
Teacher	Guide students to discuss in their groups the given class work and then asked both male and female students to work on blackboard	Teacher encourages students to ask their fellow questions in each stage.
Teachers	Provide notes to students	Teacher continues moving around to check every individual take notes and keep asking them some questions
Teacher	Provided homework on rotation matrix	Teacher makes sure that every student is active in classroom.
Students	Take notes and home work	
Teacher	Asked students to tell what they have leant today (KWL)	Teacher uses probing questioning to elicit evidence of students conceptual thinking.
	The lesson end	

The data from Extract 1.1 present an example of the lesson that teachers utilized classroom monitoring in line with formative assessment. The teacher continues monitoring what is going on in different stages of the lesson.

In terms of teachers' number of periods per week, the findings indicated that teachers with periods more than 31 obtained a mean rank = 21.39, the other groups of teachers obtained mean rank = 17.07 and 18.04, with $\chi^2 = 0.976$ and p-value = 0.614, which was not statistically significant at $\alpha = 0.05$ level of confidence. This finding implies that, the number of periods per week did not influence teachers' utilization of classroom monitoring in teaching and learning mathematics. This result further means that teachers' with more number of periods appeared to be more competent and committed than teachers with fewer numbers of periods per week. Indeed, this is very common in Tanzania where competent teachers are normally given heavy teaching load to handle.

With regard to class size, the finding indicates that teachers with students more than 50 performed slightly higher in the classroom monitoring i.e. mean rank = 20.58, while teachers with students between 40-50 obtained a mean rank = 16.15, with $\chi^2 = 1.816$ and p-value = 0.403. This was not statistically significant at α=0.05 level of confidence. This suggests that classroom size did not influence teachers' utilization of classroom monitoring during teaching and learning mathematics. The critical analysis indicates that, an overcrowded classroom did not limit teachers to conduct classroom monitoring in line with formative assessment. Evidence from classroom observation shows that, majority of teachers with overcrowding class conducted group discussion and provided classroom activities. For example, teacher T1 from school A3 teaching transformation in Form 4 class with 59 students managed to conduct group discussion, provided assignments, asked questions, encouraged students to answer questions while moving around to monitor students in their groups and marked their assignments. Furthermore, an analysis was carried out to find the average rating per each item with regard to teachers' utilization of classroom monitoring in line with formative assessment in teaching and learning mathematics. Table 1.5, presents the mean and standard deviation for each aspect of classroom monitoring in the process of teaching and learning mathematics.

Table5.1: Mathematics Teachers' Classroom Monitoring by Items

	Observed Classroom Monitoring- Items	**N**	**Mean**	**Std. Deviation**
1	Does the teacher make efforts to monitor student learning on an ongoing basis (minute-to-minute)?	36	3.1944	0.78629
2	Does the teacher give students a variety of opportunities and methods (such as verbal, written, electronic, & visual) to respond to questions?	36	3.1944	0.66845
3	Does the teacher use effective questioning strategies (such as adequate wait time, open-ended questions) to elicit evidence of learning?	36	3.2222	0.95950
4	Does the teacher seek to elicit evidence from students of both factual/procedural knowledge and of deeper conceptual knowledge?	36	2.9444	0.86005
5	Does the teacher seek to elicit evidence of whether students can transfer knowledge within and between disciplines/subjects?	36	2.0889	0.97915

Key: *N= number of respondents*

Results from Table 1.5 show that, utilization of different aspects of classroom monitoring was minimal. For example, the item that sought teachers' efforts to monitor student learning on an ongoing basis (i.e., minute-to-minute) indicated minimal use (M=3.1944, SD=0.78629). This implies that, mathematics teachers might have lacked necessary skills, techniques and knowledge to engage students in classroom activities during teaching and learning process. Similarly, the item that sought to assess teachers use of effective questioning strategies received (M=3.2222, SD=0.95950) which indicates the minimal utilization.

Similar evidence was captured from teachers in T2 school A6 who lacked knowledge about geometry and figures. The question item given to students is presented in Figure 1.1.

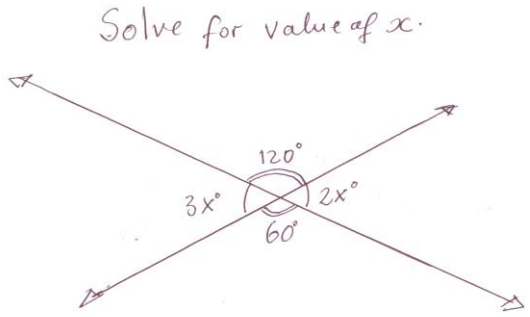

Figure 1.1: Classroom Assignment 1

Figure 1.1 indicates that the question item was poorly constructed because the opposite angles are always equal therefore, 60^0 and 120^0 contradict each other. For this case, this question cannot be solved by a Form One student. Similar mistakes were observed from the same teacher in another class (see Figure 1.2)

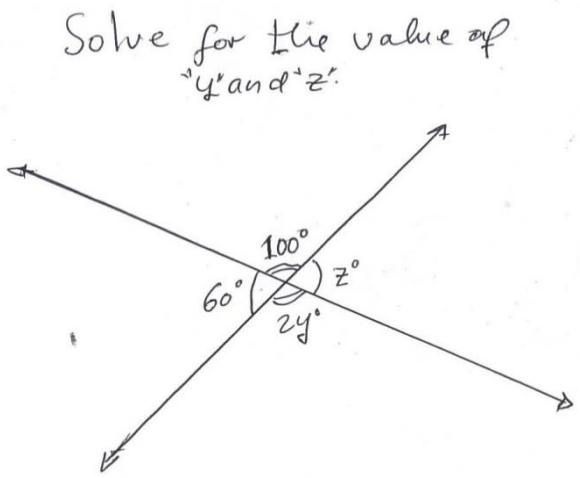

Figure 1. 2: Classroom Assignment 2

Figure 1.2 indicates teachers' poorly constructed classroom assignment items. The question cannot be solved because the straight line has a total of 180^0. During this lesson, the researcher observed the teacher solving on the blackboard, and obtained the following values z = 60^0 and y = 50^0. This example might suggest that teacher T2 from school A6 had limited knowledge and skills in teaching the topic of geometry and figures. In line with these findings, evidence from classroom observation revealed that teachers' questions could not include effective strategies such as probing, posing time for students to think and in most cases questions were recalling students' simple facts such as "*Yes"* and *"No"* answers.

On the other hand, the item that sought the ability of students to transfer knowledge among different disciplines was ineffective (M = 2.0889, SD = 0.97915). This finding implies that mathematics teachers might not have sufficient knowledge and skills to ask students questions that require them to connect learning to other topics within the same discipline or to other related disciplines while teaching and learning mathematics. Furthermore, the findings suggested that the majority of mathematics teachers lacked necessary skills and knowledge to utilize effective classroom discussion, questions and learning tasks that elicit evidence of student learning. Classroom observation revealed that teachers' questions were of low thinking order skills which did not encourage students' critical thinking. It was also noted that in most cases teachers did not give students enough time to comprehend the asked questions.

Discussion of the findings

The analysis of classroom monitoring based on sex indicated that female teachers appeared to be far better than males in conducting classroom monitoring and engineering effective classroom discussions with students. This finding concurs with the study by Nejati, Hassani and Sahrapour (2014) who found that, female teachers were better at instructional and classroom monitoring

In the same regard, the findings indicated that teachers from public schools appeared to utilize classroom monitoring more frequently than those from private schools. This observation suggested that, in public schools, teachers are more confident and experienced than teachers from private schools. This is similar to the finding by Elliot (1998) who reports that public schools had more qualified teachers than private schools although in private schools students performed well. A similar finding was given by Eva and Monica (2004) who argued that public schools had better-educated teachers than private schools. Evidence from the field indicated that teachers from public schools were more aged and had longer teaching experience than those from private schools.

In terms of teachers' teaching experience, the findings revealed that teachers with long experience in the teaching profession appeared to perform better in classroom monitoring than less experienced one. Cowie and Bell (1999) acknowledged teachers' teaching experience as an important factor in the process of utilization of formative assessment in teaching and learning. They further reported that formative assessment is more likely to occur among experienced teachers than the newly employed ones. A similar finding was reported by Ladd (2013) that more experienced teachers were on average more effective than teachers with fewer years of classroom experience.

Concerning teachers' utilization of each aspect of formative assessment in classroom monitoring, it was observed that, some items were better utilized than other. Three items that were utilized more were: making efforts to monitor student learning on an ongoing basis (minute-to-minute), giving students a variety of opportunities and methods (verbal, written, electronic, and visual) to respond to questions and effective use of questioning strategies (adequate wait time, open-ended questions) to elicit evidence of learning. The finding from classroom observation shows that common methods used by mathematics teachers *were group discussions, presentations, think pair share, individual work, question and answers, working on blackboard* and *brainstorming*.

In the same regard, the study revealed minimal utilization of some items in the monitoring aspect of formative assessment such as the items that assess teachers' ability to elicit evidence from students of both factual/procedural knowledge and teachers' ability to elicit evidence of whether students can transfer knowledge within and between disciplines/subjects. It was observed that teachers could not provide students with precise concepts or ideas and steps that were required for students to solve a given task. In

most classrooms, teachers were asking questions without additional probing questions such as *Why do you think so? How do you know that? What evidence do you have to support your claim?* Oswalt (2013) reported that frequent use of these types of questions may elicit students' conceptual knowledge in learning mathematics.

Conclusion

The findings from the study revealed the inconsistence of teachers' classroom monitoring, which might lead to poor student learning style and academic achievement. Results confirmed that sex, school types and teaching experience were determinant demographic characteristics for effective classroom monitoring in the teaching and learning of mathematics. On the other hand, the results indicate that training status, teachers' qualifications, number of periods and class size did not influence the utilization of classroom monitoring.

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