Examining Science Teachers' Practices of Formative Assessment in Tanzanian Secondary schools

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Abstract
The enrollment of secondary school students in Tanzania is on the increase, but their participation and academic performance in science subjects are low. This study employed a quantitative research approach and a cross-sectional research design to examine science teachers' practices of formative assessment. It involved 65 teachers teaching Physics, Chemistry, Biology and Mathematics in 13 secondary schools. A purposive sampling technique was used to select science teachers and secondary schools. A questionnaire and observation checklist were used to collect data. The study revealed that teachers' knowledge of formative assessment practices was low and statistically significant [t (64) = 53.752, p <0.01] with a mean of (M = 3.2250). They implemented formative assessment practices poorly, with differing magnitudes [t (64) = 49.761, p < 0.01] and a mean of (M = 2.6646) in their classes.The study recommends that teachers receive regular in-service training on formative assessment practices to enhance students learning.

Keywords: Formative assessment, science subjects' performance, cultural-historical activity theory, self and peer as assessment

Introduction

Over the past decade, there has been growing concern among both scholars and the public regarding the quality of education in Tanzania. While national efforts to improve access to education have been visible in recent years, such as a 5.5% increase in net enrollment in Forms I to IV from 2009 to 2018, rising from 29.1% to 34.6% (United Republic of Tanzania, Ministry of Education, Science and Technology, 2019), the increase in enrollment has not been accompanied by a corresponding improvement in learning outcomes. For instance, the pass rates in the Certificate of Secondary Education Examination (CSEE) have fluctuated considerably over the years, with a significant decline from 91.5% in 2004 to 42.9% in 2013 (United Republic of Tanzania, Office of the president, 2017). Although pass rates have rebounded to 77.09% in 2017 (UnistoreTz, 2018) and 78.38% in 2018 (Walker, 2020), there are still concerns about the quality of education in Tanzania. The inconsistent student performance has been particularly noticeable in science subjects, including Physics, Chemistry, Biology, and Mathematics as indicated in Table 1.

Table 1

Students' Performance in CSEE for Physics, Chemistry, Mathematics and Biology from 2016 to 2021

	Physics subject			Chemistry subject		
Year	**Pass (%)**	**Fail (%)**	**Comments**	**Pass (%)**	**Fail (%)**	**Comments**
2016	44.8	55.2	Average	59.2	40.8	Average
2017	42.2	57.8	Average	53.4	46.6	Average
2018	45.5	54.5	Average	62.2	37.8	Average
2019	48.4	51.6	Average	76.8	23.2	Good
2020	48.9	51.1	Average	87.1	12.9	Good
2021	55.3	44.7	Average	92.0	8.0	Good
	Mathematics subject			**Biology subject**		
2016	18.12	81.88	Weak	55.7	44.3	Average
2017	19.19	80.81	Weak	61.4	38.6	Average
2018	20.02	79.98	Weak	60.5	39.5	Average
2019	20.03	79.97	Weak	55.3	44.7	Average
2020	20.12	79.88	Weak	55.2	44.8	Average
2021	19.54	80.46	Weak	67.2	32.8	Good

Table 1 shows that students' academic performance in all subjects is inconsistent and varies yearly. Mathematics has the lowest performance compared to physics, chemistry, and biology. For many years, performance was average, but in a few years, it was rated "good". The most concerning trend is mathematics, where the pass rate has been consistently below 21% for six consecutive years, indicating that few students pursued science-related courses, particularly in fields requiring a pass in mathematics. Therefore, there was a need to examine science teachers' formative assessment practices.

Formative assessment (FA) is a crucial aspect of effective classroom instruction worldwide because it allows teachers to adjust their teaching methods based on students' learning information. Popham (2017) asserts that formative assessment is a continuous and interactive procedure that allows teachers and students to be active in the learning process. FA acts as a guide to monitor and assess students' learning progress, and it involves practices such as self- and peer assessment, Socratic questioning style, and feedback (Pinchok & Brandt, 2009; Popham, 2017; Ruiz-Primo & Furtak, 2007). The primary goal of formative assessment is to provide learning progress to teachers and students, helping them understand strengths and areas that need improvement.

Formative assessment (FA) practices can influence academic performance among students in national examinations like the Certificate of Secondary Education Examination (CSEE). Effective implementation of formative assessment practices, such as self-and peer assessment, Socratic questioning, and feedback, helps students build their knowledge and skills over time. When science teachers implement FA practices effectively, they can identify areas where students need extra support and adjust their teaching methods in the early stages (Popham, 2017). The feedback and learning experiences provided through formative assessment practices prepare students for normative assessments like CSEE, leading to improved performance.

Normative assessment is a type of assessment that aims to compare student's performance to a predefined standard or norm. It typically involves national examinations that measure a student's performance in comparison to a larger group or predetermined criteria (Köller, 2005). The primary purpose of normative assessment is to rank or classify students, often on a bell curve, and provide a basis for comparing students' performance with peers.

Problem Statement

In the last decade in Tanzania, the trends in secondary school students' performance in physics, chemistry, mathematics, and biology, as shown in Table 1, have raised concerns about pass rates and the consistency of education quality. Pass rates in these subjects have fluctuated, indicating varying degrees of success. The overall pass rate for the Chemistry subject was rated "good" for the years 2019, 2020, and 2021, whereas only the year 2021 was rated "good" for the biology subject; the remaining years were rated "average" and "weak" pass rates for Physics, Chemistry, Biology, and Mathematics. In other words, it implied that very few students opted to study science-related courses at higher levels of education. Andrade and Cizek (2010) assert that effective formative assessment practices such as self and peer assessment, Socratic questioning, and feedback in the classroom can enhance students' performance. As these practices help students build their knowledge and skills over time, teachers can identify areas where students need extra support and adjust their teaching methods in the early stages (Popham, 2017). Consequently, this leads to students' high academic performance in national examinations like the CSEE. Therefore, this study examined science teachers' formative assessment practices in Tanzanian secondary schools.

Research Objectives

The study aimed to achieve the following objectives

i. To investigate if science teachers' knowledge of formative assessment practices differs by the subject they teach
ii. To examine the extent to which science teachers implement formative assessment practices in secondary schools.

Research Questions

The study sought to respond to the following research questions:

i. What is the difference in science teachers' knowledge of formative assessment practices based on the subject they teach?
ii. To what extent do science teachers implement formative assessment practices in secondary schools?

Literature Review

The Concepts of Self and Peer assessment, Socratic questioning and Feedback

Self-assessment refers to the process whereby students judge their work to determine the quality of their work (Falchikov & Goldfinch, 2000). Students assess their strengths, weaknesses, and areas for improvement based on learning objectives and criteria. Additionally, self-assessment helps students develop a deeper understanding of their thought processes and learning strategies and promotes a sense of ownership and accountability for learning. Peer assessment is 'an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status' (Topping 1998, p. 250). In other words, it is a process where students provide constructive feedback to each other based on predefined criteria or learning objectives. Peer assessment encourages diverse perspectives, thus developing students with evaluative skills such as critical thinking, communication, and argumentation (Elder & Paul, 2006).

Socratic questioning is a teaching method inspired by the Socratic Method in which the teacher poses thought-provoking questions to students to stimulate critical thinking and elicit insightful responses (Elder & Paul, 2006). It includes open-ended questions that promote discussion, analysis, and idea exploration. Socratic questioning encourages inquiry-based learning, critical thinking, and a collaborative and engaging learning environment in which students actively participate (Paul & Elder, 2019). Feedback refers to the information provided to students about their learning, offering guidance on strengths and areas for improvement (Hattie & Timperley, 2007). Feedback provides precise information on what is wrong and how it can be corrected. Feedback motivates and reinforces learning and encourages students to reflect on their work and take initiative in improving their understanding.

Studies on formative assessment practices, particularly self and peer assessment, Socratic questioning, and feedback, have been conducted in different areas worldwide and have provided significant insights to teachers and students. Adachi et al. (2017) examined the benefits and challenges of self and peer assessment that academicians face in higher learning institutions in Australia. The data collected through an interview with 13 academicians revealed that the academicians perceived that self and peer assessment had benefits such as developing soft skills like communication, critical thinking, and teamwork. Additionally, the study by Adachi and colleagues found that it was challenging to implement self and peer assessment as it was time-consuming, and students were passive to engage in self and peer assessment. Although the study utilized a small sample size, it provided insights into Australian contexts.

The other study by Yan et al. (2022) reviewed 175 studies to determine the effect of self- and peer-assessment practices in China. It revealed that self-assessment (SA) and peer assessment (PA) affected students' academic performance. Similarly, Li et al. (2019) in the United States of America reviewed 59 studies to determine if peer assessment would enhance students' learning. It compared the studies of students who participated in peer assessment with those who did not participate in peer assessment. The findings showed that peer assessment developed students' soft skills. Ayana et al. (2017) in Ethiopia investigated teachers' practices and beliefs regarding peer assessment in the classroom. Questionnaires, observations, and interviews collected data from teachers. The study revealed that teachers implemented peer assessment and assessed students' learning successfully.

Furthermore, Heiniger et al. (2018) compared the Socratic and non-Socratic questioning styles in engaging students in therapeutic tasks. The study employed 144 students who filled out a questionnaire. The findings revealed that Socratic questioning was more effective in engaging and developing students' skills. In Malaysia, Dalim et al. (2022) investigated the perceptions and challenges of implementing a Socratic questioning style in the teaching and learning process. Data collected through interviews showed that the Socratic questioning enhanced students' critical skills. However, it was challenging to implement it as it was time-consuming, and teachers lacked the knowledge to implement it during classroom instruction.

In Sweden, Flodén (2017) investigated how teachers perceived student feedback and how it affected their teaching choices. The questionnaire was distributed to teachers at the University of Gothenburg's School of Business, Economics, and Law. It was discovered that student feedback was positively perceived and had an impact on teachers' teaching choices. Again, Enu and Ngcobo (2022) conducted a study in Ghana to determine teachers' knowledge and practices of feedback as an aspect of formative assessment to improve students' learning. The study revealed that the feedback provided to students during the teaching and learning process was not effective and was very rarely used to enhance students' learning.

Lema and Maro (2016) examined teachers' knowledge and how they utilized feedback in mathematics classrooms to enhance students' learning. The study used interviews, classroom observation, and documentary reviews to gather data. It revealed that teachers had limited knowledge of providing feedback and seldom used it in teaching and learning mathematics. In the same contexts, Joshua (2021) investigated the impact of providing feedback to students, and the study showed that feedback in teaching and learning improved students' academic performance.

Overall, the reviewed studies focused on one aspect of formative assessment: self-assessment, Socratic questioning style, or feedback, and they did not focus on science teachers teaching physics, chemistry, biology, or mathematics. Again, none of the reviewed studies utilized CHAT. The available study in Tanzania by Lema and Maro (2016) examined teachers' knowledge and how they employed feedback in mathematics subjects. Likewise, Joshua (2021) investigated whether feedback in the teaching and learning process would enhance students' performance. Therefore, this study filled the gap by examining knowledge of formative assessment practices focusing on self and peer assessment, Socratic questioning, and feedback among secondary school science teachers in Tanzania.

Cultural Historical Activity Theory (CHAT)

CHAT is a theoretical framework for understanding human learning and development in the context of social and cultural contexts. Soviet psychologist Lev Vygotsky and his colleagues developed it in the early 20th century (Wertsch, 1998). Vygotsky believes that a person's development is influenced not only by individual psychology but also by the cultural and historical contexts in which they live and work, which shape their cognitive processes and development (Wertsch, 1998). Furthermore, Engeström (2001) expanded on Vygotsky's work by introducing the concept of expansive learning, which occurs through a collaborative process of creating and transforming cultural practices, driving societal change. This study was framed in CHAT because it examined science teachers' formative practices such as self-and peer assessment, Socratic-style questioning, and feedback during teaching and learning process that could be achieved through classroom interaction between teachers and students during teaching and learning process.

Methods

Design and setting

This study employed a quantitative research approach and a cross-sectional research design to examine science teachers' formative assessment practices. Thirteen secondary schools and science teachers who had experience specialized in the respective science subjects were selected using a purposive sampling technique. A questionnaire was distributed to 65 science teachers (15 Physics, 15 Chemistry, 15 Mathematics, and 20 Biology) to gather information about their knowledge of formative assessment practices. The study also used observation checklists to examine their formative assessment practices during the classroom instructions.

Respondents

In this study, 65 science teachers participated, comprising 32 males and 33 females. Of the total, 15 were Physics teachers, 15 Chemistry teachers, 20 Biology teachers and 15 Mathematics teachers. These teachers possessed either a diploma or a bachelor's degree and were qualified to teach in Tanzanian secondary schools (see Table 2). The distribution of teachers across these subjects was not uniform. Notably, the number of Biology teachers was the highest among the groups because the selected schools typically had at least two Biology teachers in each school, while the number of Physics, Chemistry, and Mathematics teachers was limited in such a way that there was a maximum of two teachers in each school for each subject. Consequently, more Biology teachers were included in the study because they were the most readily available group among the selected schools. Despite this uneven distribution, the total number of science teachers who participated in the study was sufficient to provide meaningful insights into the research problem under investigation.

These teachers were teaching forms three and four students, which correspond to the third and fourth years of secondary education in Tanzania. The choice to include teachers teaching these specific classes was deliberate, as these teachers had the unique experience of teaching these classes for three to four years. It was in contrast to other science teachers, who primarily taught forms one and two. This difference in teaching experience made the inclusion

of teachers instructing forms three and four classes significant, as they possessed a deeper understanding of their students' progress over a more extended period.

Additionally, it was common practice in the selected schools for teachers to continue teaching the same class they began teaching in Form One through Form Four. In other words, these teachers taught the same group of students throughout their entire four-year secondary education journey. This extended engagement with the science teachers' students provided a valuable perspective and depth of knowledge, making them a critical group to gather relevant information for the study.

Table 2

Demographics of Science Teachers

Demographic Characteristic		Respondents				(%)
		Physics	Chemistry	Mathematics	Biology	
Sex	Female	8	6	5	13	49.2
	Male	7	9	10	7	50.8
Age (years)	<30	3	4	1	2	15.3
	30-39	8	7	8	10	50.8
	40-49	3	4	5	5	26.2
	50+	1	0	1	3	7.7
Qualification	Diploma	10	3	4	6	35.4
	Bachelor	5	12	11	14	64.6
Teaching Experience (years)	5-10	4	5	3	5	26.2
	11-16	10	10	11	12	66.1
	>16	1	0	1	3	7.7

Procedures

The study adhered to ethical standards for research involving human subjects. The researcher obtained a research permit from relevant authorities, including the Regional Administrative Secretary (RAS), District Administrative Secretary (DAS), District Educational Director (DED), and District Educational Officer (DEO) in Morogoro region, who issued an introductory letter to the heads of the selected secondary schools. Informed consent forms were prepared for teachers, who had the choice to participate or reject. Respondents were informed of the study's objectives and assured that their participation was voluntary and that their information would remain confidential. The questionnaires were distributed to science teachers in the selected schools and were left with them for three days to allow them to fill them out,

as it was difficult for them to fill them out in one or two days because they were busy with the invigilation of midterm examinations. After the agreed-upon days, all teachers managed to fill out the questionnaires, which were then collected. The researcher conducted observations three times during 80-minute lessons for each teacher to examine the extent to which teachers implement formative assessment practices during the teaching and learning process.

Instruments

The researcher developed a questionnaire with three sections. The first section consisted of teachers' demographic information, such as sex, age, qualification, and teaching experience. The second section consisted of a set of eight items to investigate science teachers' knowledge of formative assessment practices; for example, one of the items was "I am aware of how to plan my lesson appropriately and assess students using various formative assessment practices." Each item had response options ranging from 1 (strongly disagree) to 4 (strongly agree), with higher scores indicating a greater level of agreement.

The third section of the questionnaire included ten items created by the researcher to examine the extent to which science teachers use formative assessment practices such as self-and peer assessment, Socratic-style questioning, feedback, and comments. The items had response options ranging from 1 (not practiced) to 4 (well-practiced), with higher scores indicating more effective formative assessment practice implementation. The questionnaire was pre-tested with 50 science teachers from four different secondary schools who did not participate in the actual study because they would have learned about it. Any items found to be contradictory in terms of arrangement, sentence structure, or ambiguity were corrected to avoid confusion. The Cronbach's alpha of the questionnaire in the actual study was 0.705, which was within the acceptable range specified by Creswell and David (2018), making it suitable for use in the research.

Data analysis

The study's data were coded and entered into the Statistical Package for the Social Sciences (SPSS) version 21.0 for Windows. To achieve the first objective, an independent samples t-test was computed to compare teachers' knowledge of formative assessment practices based on the subjects they taught. Furthermore, a one-way ANOVA was used to compare the mean scores of formative assessment practices knowledge among teachers based on teaching subjects of Physics, Chemistry, Mathematics, and Biology. In all analyses, a p-value less than 0.05 was considered significant. The study also tested the assumptions of ANOVA: outliers, homogeneity, linearity, and normality, which were found to be valid except for homogeneity. As a result, the researcher used a Welch ANOVA and post-hoc tests to identify multiple comparisons among science teachers based on the subjects they taught. The researcher used an independent samples t-test to determine whether there were significant differences in formative assessment practices among teachers based on the subjects they taught.

Results

The first objective was "***to investigate if science teachers' knowledge of formative assessment practices differs by the subject they teach***". Prior to investigating variations in science teachers' knowledge of formative assessment practices, I first ascertained their level of agreement with statements related to their understanding of formative assessment. Responses were scored on a scale from 1 (strongly disagree) to 4 (strongly agree). It revealed that teachers had a substantial level of agreement in their understanding of formative assessment practices, as demonstrated by a significant independent samples t-test outcome [t (64) = 53.752, p < 0.01] and an average mean score of 3.2250. Nevertheless, the teachers' reported knowledge of formative assessment varied depending on the subject they taught, as shown in Table 3.

Table 3

One-Way ANOVA Results

			Test of Homogeneity of Variances		**ANOVA**	
Variables	**Mean**	**Std. Deviation**	**Levene's Statistic**	**Sig.**	**Welch Statistic**	**Sig.**
Physics	3.2750	0.35732	3.337	0.025	7.878	0.01
Chemistry	3.2500	0.45806				
Mathematics	2.7750	0.55138				
Biology	3.5063	0.26431				
Differences in Teachers' Knowledge of Formative assessment Subject wise						
Subject	**Mean difference**	**Sig.**	**95%Confidence Intervals (LL- UL)**			
Physics-mathematics	0.50000*	0.040	0.164	0.9836		
Mathematics -Biology	-.73125*	0.001	0.2819	1.1806		

***** Significance at 0.05 level

Table 3 shows significant disparities in formative assessment knowledge among science teachers who taught Physics, Chemistry, Biology and Mathematics (Welch statistic = 7.878, $p < 0.01$). Since Levene's statistic was found significant, it implied that the assumption of equal variance was not fulfilled. Dunnett's T3 was employed for post-hoc comparisons to investigate the differences between groups. The findings indicated that the formative assessment knowledge of Mathematics teachers (M = 2.7750, SD = 0.55138) was significantly low compared to that of Physics

teachers (M = 3.2750, SD = 0.35732) and to that of Biology teachers (M = 3.5063, SD = 0.26431). Nevertheless, no significant differences in formative assessment knowledge were observed among teachers who taught Physics, Chemistry and Biology.

The second study's objective was "***to examine the extent to which science teachers implement formative assessment practices in secondary schools.***" To achieve this, the overall mean score in each subject was calculated. The findings indicated that science teachers implemented partially formative assessment practices with an overall mean score of M = 2.6646 and significant independent samples t-test results [t (64) = 49.761, p < 0.01]. The results also showed that the level of implementation varied across science teachers depending on the specific subject they were assigned to teach (see Table 4).

Table 4

One-Way ANOVA Results on the Implementation of Formative Assessment Practices

			Test of Homogeneity of Variances		**ANOVA**	
Variables	**Mean**	**Std. Deviation**	**Levene's Statistic**	**Sig.**	**F**	**Sig.**
Physics	3.2733	0.19074	0.913	0.440	41.386	< 0.01
Chemistry	2.6467	0.25317				
Mathematics	2.3133	0.30907				
Biology	2.4900	0.25110				

Differences in Teachers' Classroom Practices of Formative Assessment Subject-wise

Subject	**Mean difference**	**Sig.**	**95%Confidence Intervals (LL- UL)**	
Physics-mathematics	0.96000*	< 0.01	0.6920	1.2280
Physics -Chemistry	0.62667*	< 0.01	0.3948	0.8585
Physics -Biology	0.78333*	< 0.01	0.5751	0.9916
Chemistry -Mathematics	0.33333*	0.019	0.419	0.6248

Table 4 shows that the implementation of formative assessment practices specifically self and peer assessment, Socratic questioning style and feedback among science teachers varied significantly ($F(3, 61) = 41.386$, $p < 0.01$). Mathematics teachers ($M = 2.3133$, $SD = 0.30907$) were less likely to use formative assessment than Biology teachers ($M = 2.4900$, $SD = 0.25110$), Chemistry teachers ($M = 2.6467$, $SD = 0.25317$), and Physics teachers ($M = 3.2733$, $SD = 0.19074$). Additionally, the study revealed that physics teachers actively utilized self- and peer-assessment, Socratic questioning, and feedback in their classrooms compared to other science teachers. Students engaged in evaluating both their work and that of their peers through peer review sessions, self-assessment checklists, and collaborative learning environments.

Physics teachers provided constructive feedback that guided students' learning and improved their understanding. This feedback was provided in both written form on assignments and verbally during classroom teaching. Furthermore, Socratic-style questioning was used to engage students in meaningful dialogue and explanations of concepts. By encouraging students to think critically and articulate their understanding, Physics teachers managed to assess students' comprehension and identify areas that required further clarification.

Discussion

This study examined formative assessment practices of teachers teaching Physics, Chemistry, Biology, and Mathematics in 13 secondary schools. It specifically addressed two objectives: to investigate if science teachers' knowledge of formative assessment practices differs by the subject they teach and to examine the extent to which science teachers implement formative assessment practices in secondary schools. The results of the questionnaire indicated that science teachers had adequate knowledge of formative assessment practices of self and peer assessment, Socratic style questioning and feedback [$t(64) = 53.752$, $p < 0.01$], with an overall mean score of 3.2250. However, Mathematics teachers did not agree ($M = 2.7750$, $SD = 0.55138$) that they had sufficient knowledge of formative assessment practices.

In contrast, Physics ($M = 3.2750$, $SD = 0.35732$), Chemistry ($M = 3.2500$, $SD = 0.45806$), and Biology ($M = 3.5063$, $SD = 0.26431$) teachers agreed that they had knowledge of formative assessment practices, albeit to varying degrees. These findings are in line with previous studies (e.g, Arrafii and Sumarni, 2018; Enu and Ngcobo, 2022) that reported low knowledge of formative assessment practices among teachers, leading to difficulties in implementing in their classes.

According to Black and Wiliam (1998), facilitators (teachers, tutors, instructors, and lecturers) should be equipped with knowledge and skills in different formative assessment practices to make them adaptable in implementing curriculum activities in the classroom. Student's ability to learn concepts varies; therefore, facilitators should use various FA practices such as self and peer assessment, and Socratic questioning and feedback to understand students'

learning progress. The current study's findings are consistent with previous research that found educators had limited competence in using formative assessment practices during the teaching and learning process (Yan & Cheng, 2015). The study by Yan and Cheng suggested that in-service training is required to orient facilitators on applying these FA practices effectively in the classroom, regardless of time constraints or class size.

Additionally, the study by Ombay (2020) supports the current research, indicating that although Biology teachers possessed knowledge of formative assessment practices, they failed to implement them effectively because they were unable to engage students in interactive learning environments and seldom teachers provided feedback to students. Unable to implement instant formative assessment practices during lesson delivery, teachers could not identify areas that require improvement for better learning outcomes.

The present study also found that science teachers partially utilized formative assessment practices in their classes [$t(64) = 49.761$, $p < 0.01$], with a mean of 2.6646. However, Mathematics teachers ($M = 2.3133$, $SD = 0.30907$) employed most partially formative assessment practices than teachers of Physics ($M = 3.2733$, $SD = 0.19074$), Chemistry ($M = 2.6467$, $SD = 0.25317$), and biology ($M = 2.4900$, $SD = 0.25110$). Mathematics, Chemistry and Biology teachers were unable to engage students in evaluating their own and peer work as they kept on teaching without determining the extent to which students understood concepts. Even Socratic-style questioning that demanded them to probe students' responses was not practiced; instead, they used traditional way of teaching.

Furthermore, the feedback was not provided to students, which made them not to learn because feedback would inform where and how the concepts have been mastered. This is contrary to Physics teachers who managed to engage students in self- and peer assessment, and teachers were also able to use probing questions with students, which in turn made students collaborate and interact. These results are consistent with Brookhart (2011) who found that teachers' lack of knowledge of the utilization of different formative assessment practices during the teaching and learning process resulted in a limited understanding of student learning progress. As students have different learning styles, implementing different formative assessment practices is necessary for effective teaching and learning across educational levels. Teachers' lack of knowledge about implementing formative assessment practices causes many problems in education, such as mass student failure. Most students cannot opt for science-related fields like engineering, pharmacy, or clinical medicine.

Similarly, the Poole (2016) survey demonstrated that instructors had insufficient knowledge and understanding of formative assessment practices, which could hinder their ability to achieve classroom instructional goals. It highlighted the necessity of professional development and training for teachers to provide them with the required knowledge and skills to implement formative assessment practices in their classrooms. Adequate training and support for teachers

would equip them to enhance their formative assessment practices and ultimately improve their students' learning outcomes, as teachers would understand students' learning needs.

Conclusions and Recommendations

This study has added a body of knowledge by examining science teachers' practices of formative assessment (FA) in Tanzanian contexts. The findings have broader implications not only in Tanzania but also in other countries with similar contexts. Implementing effective FA practices in the classroom, such as self-and peer assessment, Socratic-style questioning, and feedback, provides valuable opportunities for students to learn and develop essential skills such as creativity, communication, critical thinking and problem-solving. Feedback from formative assessment practices informs teachers about the effectiveness of their teaching methods and helps them make decisions. However, this study found that teachers of physics, chemistry, biology, and mathematics had different knowledge of formative assessment practices. Mathematics teachers, in particular, demonstrated a lower understanding of FA practices than their counterparts in physics, chemistry, and biology.

Furthermore, FA practices in the classroom were low, with mathematics teachers performing worse than the other science teaching groups. Teachers' inability to implement diverse formative assessment practices can impede their understanding of how students learn, leading to poor learning outcomes.

The study recommends that multiple formative assessment practices including self and peer assessment, Socratic style questioning and feedback be implemented in the classroom to gain a better understanding of student's learning progress and tailor instruction accordingly. Instant formative assessment practices during lesson delivery can offer teachers timely feedback on their students' learning progress, enabling them to adjust their teaching methods.

The government should create a conducive environment for formative assessment practices by providing adequate teaching and learning materials, such as books, and well-equipped laboratories with enough chemicals and apparatus. Again, the Tanzanian government, through the Ministry of Education, Science, and Technology, should regularly train science teachers on how to implement self and peer assessment, Socratic questioning, and feedback to cultivate better student learning outcomes. Heads of schools should organize and implement workshops so that science teachers can share their experiences on how students learn and explore more effective ways to implement FA practices in the classroom. Finally, heads of schools should provide ongoing support and monitoring to ensure that science teachers effectively implement formative assessment practices. Monitoring could be done through in-class observations, peer evaluations, and feedback mechanisms to enhance students' learning.

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