

Knowledge of Formative Assessment Practices among Senior High School Mathematics Teachers in Ghana

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ABSTRACT: Formative assessment drives classroom instruction and provides learners opportunity to self-evaluate their strength and weaknesses regarding a particular concept. The purpose of the study was to investigate Senior High School (SHS) teachers' knowledge of formative assessment. Descriptive cross-sectional survey was the design employed for the study. Census approach was used to involve 148 mathematics teachers in all the thirteen public SHS in the Cape Coast metropolis, Ghana who were the target population of the study. Questionnaire with close-ended items was developed for the data collection. It was revealed that majority of SHS mathematics teachers in the Cape Coast Metropolis had low knowledge in formative assessment practices. Further, the findings indicated a strong positive relationship between SHS mathematics teachers' knowledge of formative assessment and the practice of it. It is recommended that there should be regular workshop and in-service training programmes for SHS mathematics teachers on formative assessment practices by the Cape Coast Metropolitan Directorate of Education, Ghana Education Service.

KEYWORDS: Formative Assessment, Instruction, Feedback.

I. INTRODUCTION

Studies have shown that formative assessment practices have a positive impact or play a crucial role in the improvement of teaching and learning in the classroom (Amoako, 2018; Bahati, Tedre, Fors & Mukama, 2016; Kline, 2013; Magno & Lizada, 2015; Mayosore, 2015; Mehmood, Hussain, Khalid & Azam, 2012; Oduro, 2015; OECD, 2011; Wei, 2010). However, it is reported that teachers have lackadaisical attitude towards its practice or even some teachers do not practice it at all (APER Conference, 2006; Gashaw, 2014; Hingins, Grant, Thompson & Montarzino, 2010; McMillan, Cohen, Abrams, Cauley, Pannozzo & Hearn, 2010). Formative assessments are about checking for understanding in an effective way in order to guide instruction. They are used during instruction rather than at the end of a unit or course of study.

Formative assessment seeks ultimately to improve classroom results. According to Theall and Franklin (2010), the teacher's skills and ability, and the student's achievement of instructional objectives can be improved by improving the practices such as instructional strategies, teaching techniques, and measurement of learning. If assessment in general finds what learning gaps exist, formative assessment focuses on how to close those gaps. Formative assessment can help bolster students' ability to take ownership of their learning but this occurs only when students fully understand that the goal of the assessment is to improve learning (Trumbull & Lash, 2013). A number of studies support the view that formative assessment is not well understood by teachers (Clark, 2013) and this might probably be the reason for their lackadaisical attitude. In the 2016 West Africa Senior Secondary Certificate Examinations chief examiner's report, it was reported that poor performance of students in the core subjects especially mathematics was partly due to lack of constant practice (West Africa Examinations Council (WAEC) Chief Examiner's Report, 2016).

There are a lot of studies conducted (Amoako 2018; Andersson & Palm, 2017; Armah, 2013; Bokoe, Eshun & Bordoh, 2013; McIntosh, 2010) that have reported formative assessment practices of teachers in different subject areas and at different levels of our educational ladder however, when it comes to SHS mathematics teachers' knowledge in formative assessment and how their knowledge affects their practice, it appears not much studies have been done on it. In one of the author's personal experience in a local school as a teacher, she has observed through her interaction with the teachers that in general, their attitude towards formative assessment leaves much to be desired. The challenging aspect of this situation is that most of the teachers overlook their core responsibility of intermittently assessing their students in class for the purpose of providing feedback to improve upon teaching and learning. To this end, the questions that readily come to mind are; are the teachers aware of the tasks that constitute formative assessment? Could it be that the teachers have inadequate knowledge about formative assessment? There are no readily available answers to these questions.

This is because not much information has been documented regarding mathematics teachers' knowledge of formative assessment, and even how they practice it in the Senior High Schools within Cape Coast Metropolis. This study therefore sought to explore mathematics teachers' knowledge of formative assessment and how it relates to their classroom practices.

Formative Assessment Theory

Formative assessment theory (FAT) was initiated by Scriven, in the year 1967. Found at the basis of the theory's development, this theory stresses that formative assessment practices influence student learning when teachers apply them instructionally (Black & Wiliam, 1998). As specified by Scriven, formative methods for evaluation replaced those used in the past. In place of the older criteria and the dependent procedures, new concepts of educational readiness, strengths on which to build, deficiencies to be attacked and the likes were needed. These new concepts must be based on the assumption of dynamic potential in all or almost all human being. The evaluation task is to describe or measure phases of this potential and difficulties to be surmounted that can help the individual and the educational institution in improving student learning.

Formative assessment theory upholds that teachers should regularly diagnose and assess student learning for mastery within the classroom (Bailey & Jakicic, 2012). Moreover, teachers' diagnosis and assessment of students' learning must encompass the professional setting through collegial conversations and reflective learning experiences (Black & Wiliam, 2009). When formative assessment is practiced with fidelity, it would have a positive effect on student achievement and typically contrast with summative assessment in purpose and placement in relationship to the delivery of instruction. Proponents of formative assessment theory view the connection between cognition and the social aspect of the learning environment as an interaction that "blends cognition and social interaction into a functional theoretical framework by situating individual cognitive development in a context of collective classroom activity" (Clark, 2010, p. 347). As a result, the interplay between formative assessment theory and the tenets of cognitive theory and social constructivism enhance the overall validity of formative assessment theory (Clark, 2010).

Teachers knowledge of Formative assessment

Chun (2011) investigated challenges of school-case formative assessment in Man Tak, Hong Kong and employed a case study design. Interview and documentary analysis were the two main research techniques employed for data collection. Fifteen (15) personnel received both individual and face-to-face interview in the school. Twenty (20) pupils from primary 4 and 5 class levels were also interviewed. It was reported that teachers lacked professional knowledge and skills in formative assessment. Again, the study identified that formative assessment results in heavy workload on teachers and influence basic competency of assessment on school-base. Lastly, formative assessment brings inconsistencies in the assessment modes adopted in different class levels and subjects. Using qualitative approach in the study was not out of place, however, it would have been appropriate if the researcher used quantitative approach since this approach will allow the researcher to use quite substantial number of respondents to explore the phenomenon.

Vingsle (2014) studied teachers' knowledge and skills in formative assessment. A case study of teachers' formative assessment practices during mathematics lesson in year 5 was employed. The study was conducted in a town in the northern part of Sweden where interviews and field notes were used for data collection. A teacher and a whole class was used as a sample for the study. The purpose of the study was to identify activities and characterise the knowledge and skills that a teacher of mathematics uses in her formative assessment practice during whole-class lessons. The study revealed that formative assessment practice was very complex, demanding and a difficult task for the teacher in several ways. The study was limited in telling the knowledge level of teachers. Again, because the researcher used a single individual, it would be difficult for the researcher to generalise his findings on others hence the need for more empirical study.

Practices of Formative Assessment

Amoako (2018) analysed the methodologies and results of previous studies on formative assessment practices of teachers in Ghana. The study used seven (7) studies conducted in Ghana and published in scholarly journals. Result of the study revealed that, formative assessment procedures are well embraced and practiced among teachers at all levels of education in Ghana. The author further recommended that future researchers focus on the quantitative aspect of the phenomenon. The limitation of the study lies in the fact that limited studies were sampled from only online journals leaving a mass number of the studies in print journals.

Awoniyi (2016) conducted a study to investigate senior high school mathematics teachers understanding of school-based assessment (SBA), which is a form of formative assessment, and its challenges in the Cape Coast Metropolis. A total of 110 educators comprising 100 male and 10 female mathematics teachers were used for the study. A questionnaire and an interview schedule were used as the research instruments. Data was analysed using frequencies and percentages. The study revealed that mathematics teachers in SHS in the Cape Coast Metropolis did not have better understanding of SBA guidelines and hence did not use them and so

they continued to implement the old continuous assessment. The study failed to answer the research question on the problems that Senior High School mathematics teachers face in the management of assessment practices. Hence, this study sought to address this problem by finding out the problems mathematics teachers face in implementing formative assessment in the classroom.

Thacker (2016) examined middle school teacher's implementation of formative assessment practices in a semi-rural Northwest Georgia District in the United States of America by employing a transcendental phenomenological design. The aim was to understand these practices, centering on the teachers' live experiences with the phenomenon of formative assessment (FA) practices. The study reported using a purposeful sample of four (4) middle schools across a semi-rural northwest Georgia school district. A total of 17 co-researchers from different schools were used as the participant for the study. The data collection instrument was screening protocol, semi-structured individual interviews, a focus group, and school- and district-generated site documents. The study reported the following findings: First, the study found that middle school teachers' implementation of FA practices is evolving with new experiences and social-cultural interactions. Second, teachers desire to know their students academically, socially, and emotionally through FA practices. Third, teachers need to develop a common language and shared expectations for FA practices. Fourth, middle school teachers want leaders to collect their feedback and provide differentiated professional learning. The limitation of this study concerns the sample size used, which appears to be too small. This study addressed this limitation by involving all SHS mathematics teachers in the Cape Coast Metropolis.

Eshun, Bordoh, Bassaw and Mensah (2014) evaluated social studies students' learning using formative assessment in the selected Colleges of Education in Ghana. The study adopted a case study and was carried out in three Colleges of Education in the Central Region of Ghana. The data was used together to form one case. Both the tutors and the Colleges were purposively and conveniently selected for the study. Interviewees and classroom observation checklists were administered to nine (9) social studies tutors. The research question that guided the study was "to what extent does a tutor use formative assessment to evaluate student learning?" The study found out that few of the tutors made use of assessment techniques to improve teaching and learning process. The limitation of this study lies in the fact that the sample size used for the study was too small. Therefore, this study used larger sample size.

Research Questions

1. What is the knowledge level of SHS mathematics teachers in formative assessment?
2. What is the relationship between SHS mathematicsteachers'knowledge in formative assessment and their classroom assessment practices?

II. RESEARCH METHODS

Descriptive survey design using census method was employed for the study. The research was conducted within the Cape Coast Metropolis of the Central region. The population comprised all mathematics teachers in Central region. The target population for the study embraced all mathematics teachers in public Senior High Schools in the Cape Coast Metropolis. The total number of mathematics teachers in the thirteen Senior High Schools in the Metropolis was 152 (Cape Coast Metropolitan Education Office, 2017) but on the head count in the various schools, the mathematics teachers were 148. Census was used to involve all 148 members of target population for the study. Questionnaire with close-ended items was developed for data collection. Pilot testing was conducted using 15 mathematics teachers from Aggrey Memorial Senior High School in the Abura-Asebu-Kwamankese (AAK) District in the Central Region. The pilot testing exercise was purposely done to fine-tune the instrument (Amedahe, 2002). The Cronbach Alpha estimate of the questionnaire was .87. Even though the global Cronbach Alpha estimate for the instrument has been stated it is often important to indicate the Cronbach Alpha index of each of the sub-scales that make up the entire instrument (Quansah, 2017). The first sub-scale of the questionnaire sought to measure teachers' knowledge of formative assessment. It was made up of 10-items with a Cronbach Alpha of .62. The second sub-scale was made up of 10-items with a Cronbach Alpha index of .71. On a whole the researchers used two working days for the data collection. However, prior to the administration of the questionnaire, respondents were assured of confidentiality and anonymity. Data to answer research question one were analysed using One sample t-test whereas data to answer research question two were analysed using Pearson's product-moment correlation coefficient. Summary of the analysis were presented in tables.

III. RESULTS

Research question one

What is the knowledge level of SHS mathematics teachers in formative assessment?

This research question sought to investigate the knowledge level of SHS mathematics teachers in formative assessment. For analysis and easy interpretation, a mean score of 15 was used as the criterion measure. Mean of 15 indicated average knowledge of formative assessment. Summary of the findings is presented in Table 1.

Table 1-One sample t-test on Teachers Knowledge on FormativeAssessment

Variable	Mean	Standard deviation	N	t-value	df	Sig. (2-tailed)
Knowledge	12.51	1.470	133	-19.525	132	.000

Source: Field survey (2018)

Results from Table 1 shows that SHS mathematics teachers' knowledge level is low [$t(132) = -19.525, p = .000$]. This is more evident when the calculated mean ($M=12.51$) from Table 1 is compared with the standard average mean of ($M=15$). In this case, the calculated mean ($M=12.51$) is lesser than that of the average standard mean of 15.

Research question two

What is the relationship between SHS mathematics teachers' knowledge in formative assessment and their classroom assessment practices?

This research question sought to investigate whether a linear relationship exist between SHS mathematics teachers' knowledge of formative assessment and their classroom assessment practices. Pearson's correlation coefficient was used for the analysis and details of the result is present in Table 2.

Table 2-Pearson Product Moment Correlation Coefficient on Mathematics Teachers' knowledge and Formative assessment practices

N	Sig. (2-tailed)	Pearson Correlation (r)	Coefficient of Determination
148	.000	.821	0.67percent
$P < 0.05 \quad r^2 = .67$			

The relationship between teacher knowledge of formative assessment and classroom formative assessment practices was investigated using Pearson's Product Moment Correlation Coefficient. Preliminary analysis was performed to check whether the assumption of normality, linearity and Homoscedasticity was violated. However, none of the assumptions were found violated and so the test statistic of Pearson's r can be used. There was a strong positive correlation between the two variables ($r = .82, n = 148, P < .05$) with knowledge level of formative assessment associated with teacher practice of formative assessment in the classroom to drive instruction. Moreover, the results indicate 67 percent shared variance between the two variables, hence there is relatively strong overlap between the two variables. The inferences drawn from the statistic test result is that there is a connection between teacher knowledge of formative assessment and their frequency of practice of formative assessment in the classrooms.

IV. DISCUSSION

In general, the results from the study revealed that majority of senior high school mathematics teachers in the Cape Coast Metropolis had low knowledge in formative assessment practices. It more likely that the insufficient knowledge level of teachers in formative assessment might take it root from their training in the Universities and Colleges of Education. In Ghana, it is in the known that as part of teachers training for either 3-years diploma or 4-years degree, teachers are exposed to the dynamics of assessment just in a single course which is not enough to equip them with the requisite knowledge for the teaching job. Moreover, it is more likely that teachers in the Metropolis are not given frequent in-service training in the area of assessment with particular reference to formative assessment. In this case you could only expect them to possess but not sufficient knowledge for classroom practice. The finding is in agreement with Brookhart (2011), Heritage, Kim, Vendlinski and Herman (2009) who in their study found out that sufficient knowledge and skills on practicing formative assessment is lacking among most teachers which tend to impair their classroom. Furthermore, Chun (2011) also found that teachers have low knowledge in formative assessment in a survey and concluded that, the low of knowledge of teachers in formative assessment could deny them from achieving classroom instructional goals. This result has implications for teacher professional training and development.

Results further indicated that there is a relationship between teachers' knowledge of formative assessment and their frequency of practice of formative assessment in the classrooms. This presupposes that there is that linkage in one's knowledge level in formative assessment and the rate at which you see the person practice formative assessment in the classroom. In critical technical sense, this result actually does not suggest that once teachers have adequate knowledge of formative assessment then they would be seen practicing formative assessment in a more frequent manner. In actual sense several factors play critical role in translating

what teachers know to practice. For example, teachers' attitude and commitment toward the teaching profession as well as adequacy of resources available dictate to large extent teachers' practices of assessment for learning.

V. CONCLUSION

In a wake of a situation where teachers possess but little knowledge of formative assessment practices, there are more likelihoods that classroom assessments for learning are merely rigged with flaws which eventually deviate from its targeted purpose. Moreover, it is worth accepting that competent formative assessment practices are a function of a teacher's knowledge in such assessment procedure.

Recommendations

1. There should be regular workshop and in-service training programmes for mathematics teachers on formative assessment practices by the Cape Coast Metropolitan Directorate of Education and the Ghana Education Service.
2. Institutions of higher learning in Ghana designated to train teachers in the country should as a matter of priority direct policy to ensuring that teachers as part of their training take a course in assessment at each level of the academic ladder till they complete their 3-year or 4-year programme. This would help equip them with adequate knowledge for practice.

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