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Computer Science Teachers' Knowledge And Application Of Formative Assessment In Secondary Schools In Benin City

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Abstract: *This study examined the knowledge and application of formative assessment in teaching Computer Science in Secondary Schools in Benin City. To achieve this, three research questions were raised. The descriptive survey design was adopted for the study. The population of the study consisted of Computer Science teachers in public and private Secondary Schools in Benin City. The sample size for the study was 300 Computer Science teachers in some selected public and private Secondary Schools in Benin City. The research instrument used for the collection of data was a questionnaire titled "Secondary School Teachers' Knowledge and Applications of Formative Assessment in Computer Science Questionnaire (SSTKAFACSQ)". The validity of the instrument was determined by three experts in Measurement and Evaluation, and two others from Computer Science Education, University of Benin, Nigeria. The reliability of the research instrument was ascertained using the Cronbach alpha reliability statistics and yielded alpha values of 0.89 and 0.90. The data collected were analyzed using mean, standard deviation, and Chi-square statistics. The findings showed that the teachers had a high knowledge of formative assessment and its application in the teaching of Computer Science, and the teachers in public schools had a better level of the applications than their counterparts in private schools. The study also revealed that qualification and school ownership of teachers were determining factors in Computer Science teachers' application of formative assessment. However, the application of formative assessment was not dependent on the sex and years of experience of teachers. It was therefore recommended that public and private Secondary School teachers should be trained on the use of formative assessment in Computer Science, as well as how to use the various tools and techniques. Government at the State and Federal levels should ensure that teachers without the prerequisite teaching qualification should desist from teaching.*
Keywords: *Assessment, Computer Science, Formative Assessment, Summative Assessment, Performance*

Introduction

The need for the learners' performance to be assessed is very important in the educational system. This is because the assessment of students' learning outcomes is cardinal to the realization of the objectives of education in any economy. Assessment is important in education because it provides information about learning that can be used to diagnose learner strengths and needs, provide feedback on teaching and learning, provide a basis for instructional placement, inform and guide instruction, communicate learning expectations, motivate and focus learner attention and effort, provide practice applying knowledge and skills, provide a basis for learner evaluation (for

example grading) and gauge programme effectiveness (McTighe & Forrara cited in Afemikhe, 2014). Teaching cannot be said to be successful until an assessment proves so. Hence, Duruwuju, et al. (2010) averred that a good teacher would desire to know whether teaching has taken place or whether learners have mastered the lesson taught after the teaching and learning process. Therefore, teaching efforts may be completely invalidated if no provision is made for the assessment of progress.

Assessment has been described in several ways by scholars. For example, Rust (2002) described it as an evaluation or appraisal of students' learning outcomes. According to him, assessment involves making a judgment about the strengths and weaknesses of students in a particular subject. Afemikhe (2014) in Imasuen and Iyamu (2021) defined assessment as the various approaches to obtaining information for decision-making about students, curriculum, programmes, and policies. Chagongo (2020) sees assessment as the collection of information to ascertain students' knowledge and progress, and to make a sound instructional decision. Generally, assessment involves a whole process of collecting information for decision-making. In education, it is used to make decisions about students, teachers, educational programmes, and policies (Nitko, 1996).

Assessment is a very important and vital aspect of learning, hence, Joshua in Imasuen and Iyamu (2021), submitted that assessment is needed to know whether learners understood what has been taught. While Stiggins (2005) opined that the consistent or regular application of principles of assessment for learning can give rise to unprecedented gains in students' achievement, especially for low achievers. Assessment could either be formative or summative. Formative assessment involves assessing students' performance during the teaching-learning process and it enables teachers to identify the strengths and weaknesses of students at the early stage for remedial action, while summative assessment involves assessing students' performances at the end of a given period through testing or examination (Baka, 2008). Through assessment, teachers, parents, and learners become aware of how well or otherwise they are performing.

The role of assessment from the learners' angle is for choosing, learning, and qualifying. To do this effectively, assessment can be implemented as an assessment of learning (Summative) an assessment for learning (Formative) and assessment as learning. With assessment as learning, students are made to understand their thought processes to facilitate their learning. The student is made to relate present knowledge to prior learning as well as use them for new learning. Assessment for learning demonstrates a particular view of learning that all learners can improve and achieve their full potential. Assessment for learning is a continuous dialogue that should focus on the whole person, taking into account feelings as well as skills and understanding any barriers the learner may experience, encouraging learners to take more responsibility for their learning, and ensuring that learners are aware of what they are learning and why. Assessment for learning can take place in teaching and learning sessions, through written and verbal feedback, and as part of the review, target setting, and action planning. Information obtained from the assessment can be used to evaluate and improve learning and instruction.

Formative (or classroom) assessment–aimed at assessment for learning, and often targeting student misconceptions, is a critical omission from Computer Science education discourse and practice. All over the world, there have been numerous criticisms regarding the practice of summative assessment for the fact that its practice bestows a harmful effect on students' learning (Kapambwe, 2010). In line with this, educators from various contexts are beginning to pay particular attention to formative assessment because it serves as a reliable instructional tool for raising students' achievement (Wei, 2010). Formative assessment and the procedures that are

associated with it are now strongly advocated for use in educational interventions such as classroom instructional practices and teacher professional development (Wei, 2010).

Teachers with varying characteristics such as level of assessment knowledge have different explanations for their varying assessment practices (Koloi-Keaikitse, 2012). It is in this respect that Alkharusi, et al. (2012) stated that teachers' assessment knowledge, among other variables, does influence teachers' formative assessment practices. In other jurisdictions, educators have recognized that teachers' assessment knowledge influences their formative assessment practices. For example, Stiggins cited in Mohamed et al. (2016) contended that strong knowledge in educational assessment is a basic requirement for effective formative assessment practices in the classroom. A careful analysis of the literature suggests that a teacher's formative assessment knowledge influences his/her formative assessment practice in the classroom (Koloi Keaikitse, 2012; Alkharusi, et al., 2012). This means that teachers who are knowledgeable about classroom assessments are more likely to practice formative assessments effectively because they are more likely to integrate assessment data into their instruction to improve teaching. Empirical studies both locally and internationally suggest that teachers' knowledge of formative assessment affects their practice of assessment. Alufohai and Akinlosotu (2016) in their study stated that the majority of the teachers in secondary schools in Esan Central Senatorial District of Edo State did not have adequate knowledge in continuous assessment and that male teachers have a relatively high knowledge than their female counterparts.

In addition, Alkharusi et al. (2012) showed that teachers demonstrated a low level of knowledge in educational assessment in Oman. In Asia, Quyen and Khairani (2017) revealed that teachers lacked knowledge in the practice of formative assessment in Asian classrooms and that hindered their practice of formative assessment. It was noted that teachers did not understand the concept of formative assessment or how to implement it in their classrooms; however, male teachers tend to exhibit formative assessment knowledge more than females (Quyen & Khairani, 2017). In Ghana, Awoniyi (2016) opined that teachers did not understand School-Based Assessment guidelines as part of formative assessment which means these teachers were not abreast with new trends and development relating to assessment practices. In addition, a study by Kankam et al. (2014) from a sample of twenty social studies teachers revealed that teachers lacked knowledge of formative assessment practices. Studies on the effect of teacher experience on student learning suggested that while inexperienced teachers were less effective in formative assessment than more senior teachers, the benefits of experience appear to level off after a few years (Rivkin et al., 2000). The relationship between teacher experience and student achievement most times becomes difficult to interpret because it is highly affected by market conditions or motivation to work during the child-rearing period.

William and Keahly cited in Emeasoba (2016) opined that formative assessment provides feedback for those within the system as well as helps to improve the performance of the system. This implies that formative assessment is a vital tool that helps to promote skill development on the part of the teachers' and students' understanding of the concept being taught. Hence it is for both teachers and students. For Jones (2005), formative assessment is used by teachers during teaching to help the student understand the concept being taught and it also helps the teachers to evaluate their teaching. In all, formative assessment is essential as it aids students' understanding, identifies their needs, and responds to students' learning needs.

For students to develop a high-performance goal, high equity of outcomes, knowledge, and skills for lifelong learning, formative assessment becomes very important (Organization of Economic Co-operation and Development [OECD], 2005). Snowman and McCown (2015) averred that some teachers usually focus on the evaluation (judgment) they must make and tends to overlook the

measurement that is used to make a such evaluation and how such information can help them to teach effectively in the classroom. Researchers have used the term formative assessment intermittently with the term assessment for learning (Anderson & Osflund, 2017; Anderson & Palm, 2018).

Computer Science is an integral part of our lives, shaping virtually everything from the objects around us to how we communicate, travel, work, and play. Computer Science is a key enabler for discovering innovation in most other fields of endeavour, making it an incredibly relevant course of study. The purpose of Computer Science teaching in schools is to enable students to grasp the basic knowledge needed for further study of Computer Science and the related technologies and to understand its applications. Also, it should help the learners acquire the skill of practical utility, develop the capacity to think further and apply those skills in real-life situations. As technology makes the world shrunken, day by day, students must be made to be aware of the modernization in the social lives of industry, agriculture, national defence, and national and international affairs.

The teaching of Computer Science should aim to: provide the fundamental knowledge to the students, make the students understand the relevant knowledge and skills in computers, develop in them skills of thinking and analyzing, inculcate proficiency in reasoning and synthesizing, create interest and scientific attitudes, induce in them the thirst for acquiring knowledge, develop communicative skills and soft skills, identify their emotional intelligence, equip them with skills of using computers, and help the students attain thinking process.

Computer Science has become an increasingly important part of general knowledge. Scientific education is best fostered as a part of a general emphasis on intellectual activity. From the primary level, Computer Science teaching is given importance in schools. Increasingly, Computer Science is being incorporated into the school. At primary levels, the computer is used to display the lessons in the form of Rhymes, Games, and Browsing Intellectual mode. As per the cognitive development theories by Piaget and Bruner, the child learns through Senses, Icons, and the Enactive mode of representation. So several hands-on experiences are given to the children at this level. Moreover, simpler software applications are taught. At the secondary level, computer skills are developed. Application software like Micro soft Word (Ms Word), Excel, and Power Point are taught. It helps to develop their fundamental computer skills which leads to higher level learning. Moreover, computer simple programming languages are introduced at this level.

At the tertiary level, Computer Science teaching is at a high level. The programming skill-based curriculum is introduced at this level. The programming languages like C, C++, and Visual Basic and the web language like Hyper Text Make up Language (HTML) are in the tertiary school curriculum. It helps to develop their arithmetic and logical thinking which is reflected in their programming skills. According to Vivian et al (2020), Computer Science teachers' lack of confidence or knowledge and skills has impacted the implementation of assessments and the depth of feedback they provide. They opined that it is therefore crucial to develop teachers' capacity and influence their habits of practice to make formative assessment integral to their teaching. To be successful, Computer Science teacher assessment literacy must concentrate on both content and process, but we must first focus on what we want teachers to change about what they do, and then work on how to support teachers in making those changes. This is key because students benefit only when teachers change what they do in classrooms (and not based on what teachers think) (Williams & Leahy, 2012). Additionally, we need to build assessment measures of teacher assessment literacy that take into account the introductory Computer Science context and include factors shown to influence student assessment (DeLuca et al., 2018).

Several studies have revealed that formative assessment practices have a direct impact on the improvement of teaching and learning in the classroom if used effectively by the teachers (Amoako, 2018; Bahati et al., 2016; Kline, 2013; Magno & Lizado, 2015; Mayosore, 2015; Mehmood et al., 2012; Oduro, 2015; Organization of Economic Co-operation and Development [OECD], 2011; Wei, 2010; Imasuen & Iyamu, 2021). Some scholars contended that despite the importance of formative assessment in teaching and learning, teachers still display some non-challenge attitude towards it; some confused it with summative assessment while others do not practice it (APERA,2015; Gashaw, 2014; Higgins et al., 2010; McMillan et al., 2010). This non-challenge attitude or confusion between formative and summative assessment stemmed from the fact that formative assessment was not well understood by teachers (Clark, 2013). This had cumulated in poor performance of students in certificate examinations observed all over the world (Imasuen & Iyamu, 2021; Amoako, 2018, Anderson & Palm, 2017, Bokoe et al., 2013). Some studies have shown that teachers globally use formative assessment in teaching different subjects (Chun, 2011 in Hong Kong; Vingsle, 2014 in Sweden; Amoako, 2018 and Awoniyi, 2016, in Ghana; Imasuen & Iyamu, 2021 in Nigeria; Thacker, 2016 in the United State). However, not much study had been conducted in investigating the knowledge and application of formative assessment in teaching Computer Science. This is the crux of this study.

Research Questions

The following questions were raised to guide the study:

1. What is the level of awareness of Computer Science teachers of formative assessment in some selected public and private Secondary Schools in Benin City?
2. What is the level of application of formative assessment techniques by Computer Science teachers in some selected public and private Secondary Schools in Benin City?
3. Do demographic variables of sex, years of experience, qualifications, and school ownership influence the application of formative assessment in the teaching of Computer Science in public and private Secondary Schools in Benin City?

Methods and Materials

The descriptive survey design was adopted for the study. The population of the study consisted of Computer Science teachers in public and private Secondary Schools in Benin City. The sample size for the study was 300 Computer Science teachers in some selected public and private Secondary Schools in Benin City. They were selected from 150 public and private Secondary Schools through purposive sampling. The research instrument used for the collection of data was a questionnaire titled "Secondary School Teachers' Knowledge and Applications of Formative Assessment in Computer Science Questionnaire (SSTKAFACSQ)". The questionnaire consisted of three sections, Section A, B, and C. Section A sought information about the demographic details of the teachers such as gender, qualifications, experience, and ownership of the school. Sections B and C consisted of 14 items each for knowledge and applications of formative assessment in Computer Science. The teachers were to respond to a modified four-point scale of Strongly Agree, Agree, Disagree, and Strongly Disagree for knowledge of formative assessment, while Always, Sometimes, Rarely and Never were for application. The validity of the instrument was determined by three experts in Measurement and Evaluation, and two others from Computer Science Education, University of Benin, Nigeria. The reliability of the research instrument was ascertained using the Cronbach alpha reliability statistics and yielded alpha values of 0.89 and 0.90.

The data collected were analyzed using mean, standard deviation, and Chi-square statistics. An interpretative norm of 35.0 which was the product of the criterion mean (2.50) and the number of items in the cluster for both Computer Science teachers' awareness and application of formative assessment was used for decision-making. A mean value of below 35.00 was regarded as a low level while 35.0 and above was considered a high level. It was used to answer research questions one and two. The Chi-square statistic was used to answer research question three at a 0.05 level of significance.

Results

Table 1: The level of awareness of Computer Science teachers of formative assessment in some selected public and private secondary schools in Benin City.

Items	Mean	Standard deviation	Remarks
Formative assessment help in monitoring student progress regularly	3.07	1.03	Agree
Help teacher collects information and indicates needs	3.33	. 90	Agree
Formative assessment takes place in teaching and learning sessions through written and verbal feedback	2.93	.59	Agree
Formative assessment improves academic achievement	4.00	.00	Agree
Formative assessment increases students' motivation	3.87	.35	Agree
Formative assessment increases student engagement	2.93	.70	Agree
Formative assessment focus and targeted	3.33	.72	Agree
Personalized learning experiences	3.47	.74	Agree
Self-regulate learners	3.87	.35	Agree
Data deriving decision	3.87	.35	Agree
Promote examination malpractices	2.43	1.09	Disagree
Usually carried out at the end of a course or a program	2.43	.70	disagree
Formative assessment helps teachers' creativity	3.60	.63	Agree
Cluster means	**45.47**	**3.78**	

Table 1 showed that Computer Science teachers agreed that formative assessment helps in monitoring student progress regularly, collection of information and indicates needs, takes place in teaching and learning sessions through written verbal feedback, improves academic achievement, increases students' motivation, increases student engagement, was a focus and targeted, personalized learning experiences, self-regulate learners, was data deriving decision and helps teachers' creativity. However, they disagreed that formative assessment promotes examination malpractices and was usually carried out at the end of a course or a programme. The cluster mean of 45.47 and standard deviation of 3.78 implied that the level of awareness of Computer Science teachers of formative assessment in some selected public and private Secondary schools in Benin City was high.

Table 2: The level of application of formative assessment by Computer Science teachers in some selected public and private schools in Benin City

Items	Mean	Standard deviation	Remarks
Anecdotal records techniques	3.07	1.03	Sometimes
Feedback for students as comments and not grades	3.33	. 90	Sometimes
Test construction	2.93	.59	Sometimes

Performance assessment	4.00	.00	Always
Observation	3.87	.35	Always
Checklist	2.93	.70	Sometimes
Rating scale	3.33	.72	Sometimes
Direct questions	3.47	.74	Sometimes
Personal report	3.87	.35	Always
Written assessment	3.87	.35	Always
Portfolios	2.53	1.13	Sometimes
Sociometric	2.73	.70	Sometimes
Self-assessment	3.60	.63	Always
Interviews	3.33	.62	Sometimes
Cluster Mean	**46.87**	**3.16**	

Table 2 showed that Computer Science teachers always use performance assessment, observation, personal reports, written assessment, and self-assessment techniques in teaching Computer Science. Also, the teachers sometimes employed anecdotal records techniques, feedback for students as comments and not grades, test construction, checklist, rating scale, direct questions, portfolios, sociometric, and interviews as techniques of formative assessment. The cluster mean of 46.87 and standard deviation of 3.16 indicated that the level of application of formative assessment techniques by Computer Science teachers in some selected public and private schools in Benin City was high.

Table 3: The influence of sex, years of experience, qualifications, and school size in the application of formative assessment in the teaching of Computer Science in public and private schools in Benin City

Demographic variables		Responses		χ^2	p-value
		Low	High		
Gender	Male	120(54.5)	100(45.5)	1.023	0.312
	Female	60(75.0)	20(25.0)		
School Ownership	Private	50(50.00	50(50.0)	4.17	0.041
	Public	30(15.0)	170(85.0)		
Qualification	NCE/OND	20(25.0)	60(75.0)	10.987	0.004
	HND	110(78.6)	30(21.4)		
	BSc/BEd	10(12.5)	70(87.5)		
Experience	< 10 years	40(40.0)	60(60.0)	0.300	0.584
	≥ 10 years	60(30.0)	140(70)		

Table 3 showed that 54.5% and 45.5% of the male teachers had a low and high level of the application of formative assessment in the teaching of Computer Science in public and private schools; while 75% and 25% of the female had a low and high level. 50% of the private school teachers had a low and high level on the application of formative assessment in teaching Computer Science in Secondary Schools, while 15% and 85% of the public-school teacher had low and high levels. For qualification, 75% of the teacher with NCE and OND had a high level, 21.4 % of those with HND also had high-level application while 87.5% of those with BSc/ B(Ed) had a high and low level on the application of formative assessment in the teaching of Computer Science in secondary school. 60% of the teacher with less than 10 years of experience and 70% of the teachers with 10 years and above experience had a high level as compared to 40% and 30% of the teachers

with less than 10 years and 10 years and above teaching experience who had a low-level application of formative assessment in the teaching of Computer Science.

The association between gender, experience, and application of formative assessment in the teaching of Computer Science was not significant ($p>0.05$). However, the association between school ownership, qualification of teachers, and application of formative assessment in the teaching of Computer Science was significant ($p<0.05$).

Discussion of Findings

The study took a cursory look at public Secondary School teachers' knowledge and application of formative assessment in the teaching and learning of Computer Science. The study revealed that the level of awareness of Computer Science teachers of formative assessment in some selected public and private Secondary Schools in Benin City was high. This was supported by earlier studies by Koloi Keaikitse, (2012) and Alkharusi, et al. (2012) who stated that knowledge influenced teachers' formative assessment practice in the classroom. However, the findings were not in agreement with earlier studies by Kankam et al. (2014); Alufohai and Akinlosotu (2016); Alkharusi et al. (2012); Quyen and Khairani (2017); Awoniyi (2016); and Vivian et al (2020).

Concerning the extent of application of tools and techniques of formative assessment in the teaching of Computer Science in public Secondary Schools in the Benin metropolis, the study revealed that the level of application was high. This was attributed to the fact that the majority of the teachers sampled were able to differentiate between using summative and formative. Assessment. The findings aligned with Clarke (2012) who stated that assessing students' learning outcomes should no longer be based on the results but should seek to monitor the growth of students' learning. In another vein, Bull and McKenna (2004) stated that assessment was an integral part of the learning process and was designed to inform the learner and teacher about progress and was not used for purposes of grading or making awards. This was not supported by Kankam et al (2014); Alufohai and Akinlosotu (2016), Alkharusi et al. (2012), Quyen and Khairani (2017), and Awoniyi (2016); who observed a low level of application of formative assessment by secondary school

Another revelation from the study was that qualification and school ownership (private or public) were determining factors of public Secondary School teachers' application of formative assessment in the teaching of Computer Science. However, gender and years of experience were not found to significantly influence teachers' application of formative assessment in the teaching of Computer Science. This finding was different from the earlier results by Alufohai and Akinlosotu (2016) and (Quyen & Khairani, 2017) who observed that male teachers had a relatively high knowledge of formative assessment than their female counterparts. And also, with Rivkin et al. (2000) who noted that teacher experience on student learning suggested that while inexperienced teachers were less effective in formative assessment than more senior teachers, the benefits of experience appear to level off after a few years.

Conclusion

This study showed that the teachers had high knowledge of formative assessment and its application in the teaching of Computer Science, and the teachers in public schools had a better level of the applications than their counterparts in private schools. The study also revealed that qualification and school ownership of teachers were determining factors in Computer Science teachers' application of formative assessment. However, the application of formative assessment was not dependent on the sex and years of experience of teachers.

Recommendations

Based on the findings, it was recommended that:

i. public and private Secondary School teachers should be trained on the use of formative assessment in Computer Science, as well as how to use the various tools and strategies.
ii. the government should provide and train teachers on the art of using modern assessment techniques in the teaching and learning of Computer Science.
iii. the government at the State and Federal levels should restrict teachers without the prerequisite teaching qualifications from teaching.

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