

Entry and School-based Assessment Grades as Predictors of Senior School Certificate Examination Grades in Mathematics

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Abstract

The study investigated the extent to which students' entry grades and scores from their school-based assessment grades (i.e., end of term and mock examination grades) can predict their senior school leaving certificate examination grades in core mathematics. The study employed the exploratory research design to investigate the predictive validity of students' high school entry grades and their school-based assessment grades in determining their West African Senior School Certificate Examination (WASSCE) grades. The study involved 989 students in a high school in the Eastern Region of Ghana who took the WASSCE in 2017, 2018 and 2019. A correlation analysis of the data revealed a significant positive and moderate relationship between the core mathematics school-based assessment grades of the students and their senior school leaving certificate examination grades. Also, a multiple regression analysis of the validity of the school-based assessment scores in predicting the students' senior school certificate examination (SSCE) grades revealed that 44.1% of the total variance in students' performance in the SSCE are accounted for by three school-based assessment variables (entry grade, end of term scores and mock examination scores) when combined.

Keywords school-based assessment; predictive validity; mock examination; entry grades; end of term examination; senior school; mathematics certificate examination

Introduction

Schools exist for the purpose of teaching and learning (Ravitch, 2016). Teaching could be defined as the process of systematically guiding students to acquire certain skills, knowledge, values, beliefs and attitudes (Lino et al., 2016). According to Riccomini et al., (2015), the ultimate aim of teaching is to ensure the maximum acquisition, utilisation and manifestation of a specific knowledge or skill by a student. Teaching is done by teachers, who are usually professionally

trained, or have the required knowledge to undertake this task (Riccomini et al., 2015).

Learning, on the other hand, could be defined as the processes of making a conscious effort to acquire a specific skill, knowledge, belief or attitude (Alexander, 2015; Lino et al., 2016). It has been asserted by Steinhardt et al. (2017), that the ultimate aim of learning is the stimulate behavioural changes in the cognitive, affective and psychomotor domains of the learner. Learning cannot be directly observed, but its impact can be seen in

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behavioural changes that are displayed by a learner (Lino et al., 2016). Thus, in order to ensure learning has actually taken place, it is necessary to perform an assessment of the behavioural changes that a learner is expected to display (Yates & Johnston, 2018). This brings to the fore the need for assessment of learning in schools.

Assessment of learning is an integral part of teaching and learning in the formal school system all over the world (Brown, 2015). Assessment could be defined simply as gathering and interpreting of information relating to students learning (Yates & Johnston, 2018). Assessment is used for a number of purposes in the formal school system: it could be used to assess the progress of students in a specific area, it could be used as a tool for diagnosing students' difficulties in a specific aspect of their learning process, it could be used as a means of assigning grades to students, among others (Kaufman, 2018; Yates & Johnston, 2018). Assessment could also be used as a tool for making decisions about the students, the school curriculum, educational programmes or the entire educational policy of a country (Brown, 2015). Assessment of students learning could either optimise or inhibit the progress of student learning depending on how it is applied (Brown, 2015).

There are two basic forms of assessment that are employed in the formal education system: formative assessment and summative assessment (Dixson & Worrell, 2016; Dolin et al., 2018). Formative assessment, which is also known as assessment for learning, refers to various types of assessment that a teacher uses to determine whether students have been able to acquire the specific skill, knowledge, value, belief or attitude that a teacher expects them to acquire during a particular session of teaching and learning (Dixson & Worrell, 2016; Lau, 2016). Formative assessments usually help teachers monitor students'

learning and also enable them to determine what steps to take after a session of teaching and learning (Dolin et al., 2018). Examples of formative assessment include class exercises, class tests, home works, and others.

Summative assessment, which is also known as assessment of learning, refers to the various types of assessment used by teachers to measure learning outcomes and give reports to students, parents, school administrators and others regarding the performance of students during an instructional unit such as a semester, a term or an academic year (Dolin et al., 2018; Lau, 2016). Usually assessment of learning is used to assign grades or to evaluate students' achievements relating to complete courses (Dixson & Worrell, 2016). Examples of summative assessment include end-of-term examinations, end-of-year examinations, mock examinations and others.

Both assessment for learning and assessment of learning are part of what is known as school-based assessments (SBA) (Yates & Johnston, 2018). School-based assessments are usually considered internal examination of student learning and are therefore distinct from external examination (external assessments) students usually take for the purpose of the award of certificates (Opara et al., 2015; Yates & Johnston, 2018).

The performance of a student during both formative and summative assessments could be influenced by several factors. According to Thiele et al. (2016), for instance, the level of teacher knowledge and commitment could significantly affect their method of teaching, which in turn, could affect the performance of the students during either formative or summative assessment sessions. It has also been argued by Amro et al. (2015), that the teaching and learning environment as well as the level of commitment shown by students during teaching and learning sessions could also significantly affect the performance of the students during assessments. Several other

factors including the availability of teaching and learning materials, the amount of interest parents show in the education of their children, socio-economic conditions prevalent at home and others have also been identified by studies including Amro et al. (2015) and Thiele et al. (2016), as other factors that could affect the performance of students during formative or summative assessments.

Using school-based assessment as a means of interpreting and predicting students' performance has been challenged by some researchers (Heffner & Antaramian, 2016; Klusmann et al., 2016) due to many factors. For instance, according to Lane et al. (2015), Klusmann et al. (2016) and Quansah et al., (2019), many teachers lack the adequate training in school-based assessment. In other words, the ineffectiveness and inefficiency of the teacher in conducting school-based assessment could significantly affect the students' performance during any such assessment. This calls into question the validity of using school-based assessment to predict the academic performance of students, since many teachers are not well trained in the use of school-based assessment practices (Lane et al., 2015; Klusmann et al., 2016).

As well, the use of assessment as a method of determining how much students have learnt have also been called into question by researchers such as Dabone et al., (2015) and Ofori & Achiaa (2018), who posit that examinations, especially final examinations (to be precise, summative assessment) does not truly reflect how much students have learnt a particular topic or lesson since students have the idea that examinations is the ultimate determinant of how their academic performance is rated, they learn just to pass examinations (rote learning) (O'Grady & Dusing, 2015). The increase in examination malpractices in recent years, for instance, has been used to support the suggestion that school-based assessment, especially summative assessment does not realistically

reveal the extent to which a student has learnt a topic since they could find ways of passing the exams without actually learning the topic – through examination malpractices (Ofori & Achiaa, 2018). These factors caused researchers such as Dabone et al. (2015), and Ofori & Achiaa (2018), to question the authenticity of using school-based assessment as a predictor of students' performance.

However, there are other researchers who have made a strong case for the use of school-based assessment in predicting the performance of students. According to Mills & Mereku (2016), for instance, by revealing what students already know and what they need to learn, assessment enables teachers to build on existing knowledge and provide appropriate scaffolding on which future lessons could be based. This could heavily influence how much they perform in such future lessons. It has also been argued by Asamoah & Derkye (2019) that students' performance cannot be seen as a separate entity from their ultimate learning. These researchers are of the view that since school-based assessment (which reveals students' performance) also enables teachers to improve their teaching style and methods, school-based assessment is a necessary part of the overall learning process that students have to go through.

Both school-based assessment and certificate examinations (external assessment) are part of the Ghanaian Senior High School educational system. Students in Ghanaian Senior High (and or Technical) Schools are assessed using the various school-based assessments. They are also made to take the West African Senior School Certificate Examinations (WASSCE) which is used to award certificates that indicate the completion of the Senior High (and or Technical) School curriculum. The WASSCE is organised by the West African Examinations Council (WAEC) annually for students in the final year of the three-year Senior High (and or Technical) School system

in the country. The examinations are conducted for compulsory subjects as well as elective subjects.

Mathematics is one of the most important subjects studied by students in the Ghanaian educational system (Seah et al., 2017; Mensah, 2018). It is a compulsory subject that Ghanaian students must study and write examinations on from the basic school level to the Senior High School level (Fletcher, 2015). Other students who move to tertiary institutions such as Colleges of Education are made to continue to study Mathematics as a compulsory subject. The subject could also be studied at the university level in Ghana. A pass in the subject is usually required before a student is promoted to the next level in the educational system (Seah et al., 2017; Mensah, 2018). This indicates just how important the subject is as far as the educational system of the country is concerned.

However, the subject has a reputation of being considered difficult by students throughout the educational system of the country and many a time, students' performance in the subject during the external certificate examinations always comes under scrutiny due to consistent poor performance of students in the subject (Mensah, 2018). Considering the fact that these students got to the stage of writing external examinations in Mathematics because they were deemed ready to do so, it could be argued that, the performance of the students in Assessment in Mathematics during teaching and learning should reflect their performance in WASSCE in Mathematics. It is therefore necessary investigate whether Assessment could be used as a predictor of the performance of students in Mathematics during the certificate (final) examinations.

Objectives of the Study and Research Questions

This study was guided by the following objectives:

1. To investigate the relationship between students' Assessment grades and their WASSCE grades in Core Mathematics.
2. To determine the type Assessment grade that best predicts students' WASSCE grades in Core Mathematics.

To achieve these objectives, the following research questions were formulated:

1. What is the relationship between students' core mathematics scores in school-based assessments (i.e., end of term and mock examinations) and their senior school leaving certificate examination grades?
2. Which type of school-based assessment (i.e., end of term and mock examinations) scores best predicts students' senior school leaving certificate examination grades in core mathematics?

Methodology

The study is an exploratory research. An exploratory research is a research design that is used to investigate a research problem that is not clearly defined or understood (Quinlan, et. at., 2019). It is intended to provide researcher and high school stakeholders with a deeper understanding of how well school-based assessment are supporting the students' achievement so as to take steps to improve teachers' practices. The present study acts as a groundwork to further research into how to improve assessment practices in senior high school core mathematics.

The targeted population was estimated at nine hundred and eighty-nine (989) final-year

WASSCE students who wrote the SCCE in 2017, 2018 and 2019. Of this number, 52.9% were males, whereas 47.1%, females. A census technique was adopted to ensure that every member of the population was included. Instruments used for the collection of data were SSCE core mathematics data proforma sheet, students' school-based assessment records sheets and students' admission records. The students' school-based assessment scores were converted into grades using the WASSCE grading system as follows: 100 - 75% → 1; 70 - 74 → 2; 65 - 69 → 3; 60 - 64 → 4; 55 - 59 → 5; 50 - 54 → 6; 45 - 49 → 7; 40 - 44 → 8; 0 - 39 → 9. The data collected on all the variables were therefore brought to the ordinal level to meet the assumptions for the use of Spearman's rank-order correlation. The data were further tested and found to meet the assumptions for multiple regression analysis.

examination scores (MES); the residuals were normally distributed.

Result and Discussion

What is the relationship between students' Assessment grades and their WASSCE grades in Core Mathematics? (Research Question 1)

The first research question of this study is to establish the relationship between students' school-based assessment (i.e., end of term and mock examination) scores and their senior school leaving certificate examination grades. To answer this question, a correlation analysis using the Spearman's rank-order correlation was performed on the outcome variable (WASSCE grades) and the independent variables (end of term examination scores (ETES), mock examination scores (MES) and Entry grades. The test was conducted at the 0.05 significance level in order to establish if

Table 1 Results of the correlation between WASSCE grades as outcome variable and ETES, MES and Entry grade

		Entry Grade			WASSCE
		BECE	ETEG	MEG	Grade
Entry BECE Grade	Correlation Coefficient	1			
	Sig. (2-tailed)				
	N	989			
End of Term Exam Grade ETEG	Correlation Coefficient	0.736	1		
	Sig. (2-tailed)	0.000	.		
	N	989	989		
Mock Examination Grade (MEG)	Correlation Coefficient	0.724	0.774	1	
	Sig. (2-tailed)	0.000	0.000	.	
	N	989	989	989	
WASSCE Grade	Correlation Coefficient	0.572	0.544	0.572	1
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	989	989	989	989

** . Correlation is significant at the 0.01 level (2-tailed).

That is, a linear relationship was observed between the outcome variable (WASSCE grades) and the independent variables (end of term examination scores (ETES) and mock

a relationship really existed between the variables. The results of that analysis are presented in Table 1.

The results from the Spearman's rho correlation analysis revealed that there exists a significant relationship ($r = 0.572$; $p\text{-value} = 0.000$) between the students' entry grades (BECEG) and their WASSCE grades. This implies that the null hypothesis that there is no significant relationship between students' entry grades and their performance in core mathematics at the WASSCE is rejected, and the alternate hypothesis that there is a significant relationship between students' entry grades and their performance in WASSCE core mathematics is accepted.

From Table 1, it could also be noticed that there is a high statistically significant relationship ($r = 0.544$; $p\text{-value} = 0.000$) between the students' performance in the final end of term exam (ETEG) in the core

Which type of Assessment best predicts students' WASSCE grades in Core Mathematics? Research Question 2:

To determine type of school-based assessment that best predicts students' WASSCE grades in core mathematics, a multiple regression analysis was performed. Tables 2 and 3 present the results from the multiple regression analysis model for school-based assessment and students' WASSCE grades in core mathematics.

As can be seen from Table 2, the three school-based assessment variables (BECE entry grades, ETEG, and MEG) jointly correlate positively with the performance in WASSCE core mathematics ($R = 0.664$). This implies that the variables are relevant in explaining students' performance in WASSCE core

Table 2 Summary of Multiple Regression for Assessment

R	R Square	Adjusted R Square	Std. Error
0.664	0.441	0.439	1.283

**Predictors: (Constant), Mock examination grade, Entry BECE grade, Final end of term exams grade

mathematics and their performance in the WASSCE. Similarly, a moderate statistically significant relationship ($r = 0.572$; $p\text{-value} = 0.000$) was observed between the students' performance in the Mock Examination (MEG) in core mathematics and their performance in the WASSCE.

Per the results from the Spearman's rho analysis, all the three school-based assessment variables had statistically significant relationship with the students' WASSCE performance. As well, the results revealed that the relationships were positive and moderate.

mathematics to an appreciable extent. The table also shows R-square of 0.441 and adjusted R-square of 0.439. This implies that 44.1% of the total variance in students' performance in WASSCE core mathematics accounted for by the three school-based assessment variables (BECE entry grades, ETEG, and MEG) when combined.

However, in Table 3, the Beta weights provide an indication of relative effects of each of the predictor variables (BECE entry grades, ETEG, and MEG) on the prediction of students' WASSCE grade in core

Table 3 Results from the Relative Effects of the Assessment (predictor variables)

Model	Unstandardized Coefficients		Standardized Coefficients	T	p-Value
	B	Std. Error	Beta		
(Constant)	3.218	0.128		25.054	0.000
Entry BECE grade	0.230	0.038	0.220	6.083	0.000
Final end of term exam grade	0.121	0.033	0.156	3.703	0.000
Mock exam grade	0.293	0.035	0.350	8.427	0.000

* Significance defined $p \leq 0.05$; ** Dependent Variable: WASSCE grade

mathematics when the other variables are controlled. The value of t-ratio associated with the predictor variables (BECE entry grades, ETEG, and MEG) are significant at p values of 0.000, 0.000 and 0.000 respectively, which are all less than the significant level of 0.05. Moreover, it could be observed that the students' mock examination grade has the greatest influence on their WASSCE grades (Beta=0.350, $t = 8.427$, $p < 0.05$), followed by BECE entry grades of the students (Beta= 0.220, $t = 6.083$, $p < 0.05$) and lastly students' final end of term exams grades (Beta= 0.156, $t = 3.703$, $p < 0.05$). This means that students' mock examinations grades best predict their WASSCE grades in core mathematics.

Discussion

This study was carried to investigate whether school-based assessments are predictors of students' grades in WASSCE core mathematics. The results from the Spearman's Rank-Order (Spearman's rho) correlation analysis performed revealed that there was a statistically significant relationship between the school-based assessments grades and their WASSCE grades in core mathematics. Thus, students' school-based assessments (BECE entry grades, ETEG, and MEG) significantly correlated positively and moderately with WASSCE grades. The finding is in consonance with the findings of a similar study conducted by Bosson-Amedenu (2017a)

who found out that there was a significant relationship between school-based assessment grades in mathematics and students' performance in the WASSCE.

Also, the results from the multiple regression analysis showed that the students' mock examination grades had the greatest predictive power on their WASSCE grades ($t = 8.427$), followed by BECE entry grade of the students ($t = 6.083$) and lastly students' final end of term exams grades ($t = 3.703$). It could be revealed from the results that students' mock examinations grades among others (BECE entry grades and final end of term exams scores) best predicts their WASSCE grades in Core Mathematics. The result of the findings supported the claim of Bosson-Amedenu (2017a) who investigated the predictive validity of mock mathematics for WASSCE and concluded that mock mathematics helped significantly in predicting success in academic performance of students in WASSCE mathematics.

Conclusion

Per the results of this study, there was a statistically significant positive and moderate relationship between the performance of students in Core Mathematics Assessment and their performance in core mathematics in the WASSCE. It was also discovered that mock examination grade was the best predictor of

the students' performance in Core Mathematics during the WASSCE.

Recommendations

- Teachers should be supported with more resources to regularly carry out
- through in-service training and workshops to carry out assessment especially mock examinations more effectively since their scores are good pre-predictors of students' grades in core Mathematics.
- There should be proper supervision and monitoring of School Based Assessment in Senior High Schools so as to ensure validity and reliability of assessment data.

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Entry and School-based Assessment Grades as Predictors of Senior School Certificate Examination Grades in Mathematics

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