Predictive Validity of Continuous Assessment Grades and Students' Performance in Mathematics of Junior Secondary Certificate Examination in Cross River State, Nigeria

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Received April, 2023, Accepted May, 2023, Published June, 2023

Abstract

The study investigated the predictive validity of Continuous Assessment grades and students' performance in Mathematics of Junior Secondary Certificate Examination in Cross River State. Ex-post facto research design and stratified sampling technique was adopted for the study. The population of the study consisted of JSS3 students from 253 public schools in the State. Three academic sessions of 2017/2018, 2018/2019 and 2019/2020 were considered in the study of which the following samples: 397, 398 and 396 were drawn respectively. The data was collected through two inventory methods namely: Continuous Assessment Grades in Mathematics (CAGM) and the Junior Secondary Certificate Examination Grades in Mathematics (JSCEGM). The analysis was carried out using correlation coefficient and regression analysis with the aid of statistical package for social science. Three research questions on correlation between CA and JSCE were raised and three hypotheses were formulated respectively and tested at the 5% level of significance. The findings of the study revealed that there was weak linear relationship between grades obtained in CA and JSCE performance in Mathematics for 2017/2018, 2018/2019 and 2019/2020 academic sessions. The study recommended that CA scores should not be inflated by schools in order to serve the purpose of predicting the performance of students in public examinations. More so, schools should adopt Item Response Theory and its application to reduce inaccuracy of measurement or lack of objectivity resulting in assessing the students' true ability. The Government should ensure that incompetence in the operation of CA by teachers should be checked through training, and should encourage uniformity and standardization in administering CA across secondary schools in the State.

Keywords: *Continuous Assessment, Measurement Error, Predictive Validity, Item Response Theory, Junior Secondary Certificate Examination.*

Introduction

The technological, social and economic advancement of a country is mostly linked with student academic achievements in schools. It's necessary to review from time to time the methods of teaching/ learning in schools; and to establish effective ways of regularly assessing the students. Assessment is basically utilize to find out how much students have acquired knowledge and quality

learning of what he or she has been taught in order to compete effectively in internal and public examinations. In other words, assessment is a process evaluation often used by teachers to regularly motivate students to learn and improve on their performance. Though, more assessment implies more motivation and thus better achievement; but sometimes human behaviour may change because of regular assessments which may lead to stress on the part of the students. The motivation for studying the effects of continuous assessment on students' academic achievement is the theory of Classical Conditioning by Pavlov (1906) who observed that a dog learnt to salivate whenever a bell was rung. Pavlov undertook many trials and each time the bell sounded, the dog salivated and food was simultaneously presented. The Conditioned Response (CR) is the attainment of good grades by the students evoked by the Conditioned Stimulus (CS) meaning continuous assessment; and Unconditioned Stimulus is the teaching given to the students. The conditioning theory is relevant in the recent study because it is assumed that students obtained good grades whenever subject matter/ content are taught, followed by effective continuous assessment. Ankeli, Rogers and Shombi (2022) emphasized that the use of continuous assessment has enabled students to experiment with effective study habits. According to them, students are so immersed in constant, uninterrupted study regimens of which has resulted in verified results among students of all levels.

In Educational measurement, the theoretical basis of continuous assessment is that every measurement outcome contains some amount of error. That is, observed score is a composition of true score and error score expressed as: $X = T \pm E$. Where X = observed score; T = true score and E = error score (Spearman, 1904).

The error is derived from faulty instrument administered to students and the learning environment. To overcome the problem, measurement experts suggest that the true ability of the student could be estimated by taking many assessments of the student scores and thereafter taking the average assessment. More so, the true ability of the students could be obtained through the teachers adopting the Item Response Theory and its applications. The theory projected that the students' true abilities and achievements could be identified based on the response pattern on the test items. That is, the students' strengths and weaknesses in terms of the subject area and test items

could be clearly identified for appraisal by the teacher. Moreover, this step would enable the teachers to improve their teaching and diagnostic skills; because teachers ought to know the true ability of the students they taught through process assessment and consequently predict the students' performance in public examinations.

In our Educational system Continuous Assessment is often regarded as a comprehensive mechanism for grading students' performance in the cognitive, affective and psychomotor domains of learning (Federal Ministry of Education Science & Technology, 2022). It was first introduced into the Nigerian School System in 1982, alongside the 6-3-3-4 system of education. The National Policy of Education in Nigeria recommended a two-tier secondary educational system, the Junior Secondary School (JSS), and the Senior Secondary School (SSS). The duration for each of the two levels is three years (Federal Republic of Nigeria, 2004). At the end of the duration, the JSS and SSS students write Junior Secondary Certificate Examination (JSSCE) and the Senior Secondary Certificate Examination (SSCE) respectively. Continuous assessment is carried out in a manner that is systematic, cumulative, comprehensive and guidance-oriented, thereby ensuring that relevant information, from which far reaching decisions affecting the learner's academic and future life could be taken. This policy was made with the aim of replacing the one-shot, summative evaluation that was then in practice in the system at the end of each school year. Nwachukwu and Ogudo (2014) asserted that teachers are not assessing the students comprehensively in the three domains of learning rather they resort to the assessment of cognitive domain alone and paying less attention to affective and psychomotor domains.

Ayodele (2021) opined that the differences in the quality of tests and other assessment instruments used in different schools as well as differences in the procedures of scoring and grading the various assessments in the various schools poses problem of comparability of standard. Also, Nwoko (2016) opined that continuous assessment is a method of appraisal in which students' achievements in the cognitive, affective and psychomotor domains are determined using scores obtained from

various instruments like mid-term tests, homework, assignments, quizzes, practice sessions, laboratory, worksheets and classroom participation.

Nnorom, Ezenwagu and Okonkwo (2020) examined continuous assessment as a predictor of academic performance in Okigwe Zone secondary schools in Owerri, Imo state. The study adopted the survey research design. The population of the study included all the 66 public secondary schools in Imo state, Nigeria. The respondents' populations of the school were 8,700 (132 Principals and 8,568 teachers) and randomly sampled 1,740 respondents (26 principals and 1,713 teachers) was selected and this represented 20% of the respondents population. Data was collected through the use of questionnaire designed by the researchers. Rating scale tagged "Continuous Assessment as Predictor of Students Academic Performance Questionnaire (CAAPAPQ)''. The questionnaire had 13 items and test retest statistical method was used to determine the reliability coefficient of the instrument (0.89). Two research questions and one hypothesis guided the study. Weighted mean was used to answer the questions while z-test was used to test the hypothesis at 5% level of significance. The finding of the study revealed that continuous assessment is essential for academic success of the students. Based on the findings, it was recommended that schools should set aside a particular body that will carry out the duty of continuous assessment from time to time in the school. This will enable the school to know the areas the students are lacking and find ways to correct it. Feedbacks from continuous assessment unit should be given urgent attention. This will help the school to correct mistakes in their early stages; and teachers should be educated on how to conduct assessment on the students to improve academic achievements.

Onihunwa et al (2018) investigated the 'Roles of Continuous Assessment (CA) Scores in Determining the Academic Performance of Computer Science Students in Federal College of Wild Life Management'. The study specifically sought to find out the different assessment strategies, frequency of continuous assessment and their contribution to students' academic performance. Continuous assessment scores and the final grades obtained in some ND1 and ND2 courses offered by current ND2 students of 2013/2014 sets of National Diploma students of computer science department in the college were collected for the study and correlational analysis was performed on

the data collected. The results of the study showed that the students' scores obtained in the final examination was a function of the scores obtained in the C.A. Hence, it was concluded that if the disadvantages of continuous assessments (which include teacher subjectivity, the existence of different standards, high implications on time in terms of record keeping etc.) were well taken care of, effective continuous assessments will improve the performance of the students during a given period of schooling. It was recommended that lecturers should focus their efforts on making CA tests more efficient because it has appreciable effects on the students' examination score.

Asabe (2022) investigated the effects of Continuous Assessment on Academic Achievement of NCE Chemistry Students in Kaduna state. The population of the study comprised all chemistry students in Colleges of Education in Kaduna State. The sample consisted of 90 chemistry students drawn from the Colleges of Education in Kaduna state. A pre-test- post-test experimental control group design was used. The experimental group was divided into two groups: E1 and E2; one group served as control group. The experimental group EI was subjected to two sets of continuous assessment while E2, the second experimental group was subjected to four sets of continuous assessment and finally the control group C was left without any continuous assessment. Pre-test and post-test were administered to the three groups. Five hypotheses were stated. Two instruments, teacher made test (TMT) was used for the continuous assessment and Organic Chemistry Test (OCT) was used as both pretest and post test. The data obtained were analyzed using F-test, ANOVA, t-test, and Pearson product moment correlation coefficient statistics at 5% level of significance. The findings of the study revealed that continuous assessment has significant effect on academic achievement of NCE students. It was observed that there was no significant difference in the achievement of male and female students exposed to fewer CA. Rather, there was a significant difference in the achievement of male and female students exposed to many CA. There was no significant correlation between CA scores and final examination scores of NCE chemistry students. In the light of the findings from this study, it was recommended that chemistry teachers should strive to see that at least four CA are given to students per semester in order to improve their

academic achievement and that teachers should also be properly trained on the methods and techniques of continuous assessment construction and administration for the system to be effective.

Continuous Assessment therefore, represents a continuing awareness of the development of the students over a period of time and the general building of cumulative judgment. Continuous assessment is a school-based process also seen as process evaluation; it does not only measure advancement but also indicates the progress towards it. In the sciences, especially for a core subject like mathematics; assessments should seek to measure certain qualities that the curriculum seeks to foster in students through: regular assignments, practical work and weekly tests; this is to effectively equip the students to acquire basic knowledge and skill in the subject. In general, it is obvious that mathematics is a compulsory subject for every individual to function effectively and efficiently in today's world irrespective of one's profession (Githua & Mwangi, 2003; Blank, Alas & Smith, 2007) hence, the success of the students in the subject depends on the effectiveness of the teaching and learning process. It is in recognition of the relevance of mathematics as a core subject in our secondary schools and the low achievement often obtained by students in this subject that has generated great concern amongst, teachers and other stakeholders in education. They see students' low achievement in mathematics as wasted efforts and confusion as to whether time, energy and resources put in are in vain. On the part of the students, failures result in a set-back, a damaging effect on personality development and distortion of self-concept (Effiom, 2016; Umoinyang, 2022). Statistics from the past three years of Junior Secondary Certificate Examination (JSCE), Mathematics in Cross River State for: 2017/2018, 2018/2019 and 2019/2020 (State Secondary Education Board Calabar, 2022) academic sessions recorded low achievement. The record showed that 42.6%, 39.4% and 50.2% respectively of the students had credit and above in mathematics. Thus, the grades obtained by students in their continuous assessment in mathematics do not show appreciable correlation with the JSCE grades in the same subject; which shows that the true ability of the student were not properly integrated as teachers inflate students' continuous assessment scores. Relatively, the result analysis supported Enukoha (2021) assertion that continuous assessment scores in most schools in the country lacked merits as teachers are incompetent in

teaching and assessing their students and hence; continuous assessment may not be a valid predictor of Junior Secondary Examination grades. Test experts recommends that schools should adopt the Item Response Theory and its application in order to reduce inaccuracy of measurement and lack of objectivity resulting from measurement errors derived from raw scores so that; the students' true ability could be match to test item to reveal their achievement level and aptitude (Baker, 2001; Joshua, 2005; Natarajan, 2009; Effiom, 2020). Therefore, the problem of this study is to find out if exposure of students to many continuous assessments can validly predict their performance in public examinations.

Research Questions

To determine the predictive validity of Junior Secondary Certificate Examination, the following research questions were posed:

1. What is the relationship between the grades obtained by the students in Continuous Assessment and the Junior Secondary Certificate Examination performance in Mathematics for 2017/2018 academic session?

2. To what extent can the Continuous Assessment grades predict the Mathematics performance of Junior Secondary Certificate Examination for 2018/2019 academic session?

3. To what extent can the Continuous Assessment grades predict the Mathematics performance of Junior Secondary Certificate Examination for 2019/2020 academic session?

Research Hypotheses

The following hypotheses were formulated in order to guide the conduct of the study:

H_1: The students' Continuous Assessment grades do not predict their performance in the Junior Secondary Certificate Examination in Mathematics for 2017/2018 academic session.

H_2: The students' Continuous Assessment grades do not predict their performance in the Junior Secondary Certificate Examination in Mathematics for 2018/2019 academic session.

H_3: The students' Continuous Assessment grades do not predict their achievement in the Junior Secondary Certificate Examination in Mathematics for 2019/2020 academic session. **Methodology**

The study used stratified sampling technique from 253 public schools in the three Education Zones of Cross River State. The population of registered JSS3 for 2017/2018, 2018/2019 and 2019/2020 academic sessions were 51654, 69429 and 42836 (State Secondary Education Board Calabar, 2021) respectively. Using the Yamane's formula to derive sample size: $n= N/\{1+N(e)^2\}$ (Evans, Hastings & Peacock, 2000). Where: n = sample size; N = population size and e = margin on error in the calculation.

The samples calculated from the respective academic sessions were: 397, 398 and 396 respectively. The Ex post facto design was used to examine how an independent variable (continuous assessment grades), present prior to the study affects a dependent variable (Junior Secondary Certificate Examination performance in mathematics). The investigator made use of two instruments for data collection as the inventories provided by the State Secondary School Education Board, Calabar for the sampled schools namely: Continuous Assessment Grades in Mathematics (CAGM) and the Junior Secondary Certificate Examination Grades in Mathematics (JSCEGM) of the respective academic sessions. The analysis was carried out using correlation coefficient and simple regression analysis with the aid of statistical package for social science. For convenience, the grading used for the CA and JSCE were converted to suit the purpose as follow: letter grades A, C, P and F into grade point 3, 2, 1 and 0 respectively. The research question were answered using Correlation Coefficient (R); and the hypotheses were tested at 5% level of significance using simple linear regression (SLR) analysis. The cut off values for 'R' according to Awotunde and Ugodulunwa (2002. P. 93) are:

0.00 – 0.25 = Weak relationship

0.26 – 0.50 = Moderately weak relationship

0.51 - 0.75 = Moderately strong relationship

0.76 – 1.0 = Strong Perfect relationship.

Results of findings

In Table 1, the simple regression analysis on the relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination in Mathematics produced a correlation coefficient of .211 implying that there exists a positive weak correlation between the grades obtained in CA and JSCE by the students. The adjusted R^2 value of .162 indicated that Continuous Assessment accounted for only 16.2% of the determinant of JSCE performance in Mathematics. The F-value of the Analysis of Variance (ANOVA) obtained from the regression table was F = 23.136 and with a p-value of .000 involving 1 and 395 degrees of freedom at .05 level of significance. The implication of this result is that the p-value was not significant hence null hypothesis which stated that; the students' Continuous Assessment grades do not predict their performance in the Junior Secondary Certificate Examination in Mathematics for 2017/2018 academic session was rejected while the alternate was upheld. This result therefore showed that there is a weak linear relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination performance in Mathematics for 2017/2018 academic session.

Table 1: Simple Regression analysis of the predictive influence of CA grades on their JSCE performance in Mathematics for 2017/2018 academic session

R	**R^2**	**Adjusted R^2**		**Std. Error of the Estimate**	
.211	.162	.104		10.2413	
Model	SS	DF	MS	F	Sig
Regression	10214.311	1	9470.116	23.135	.000
Residual	28131.104	395	204.143		
Total	**38345.415**	**396**			

a. Predictors (constant): CA grades in Mathematics
b. Dependent variable: JSCE grades in Mathematics

Result from Table 2 shows that in 2018/2019 academic session the Correlation Coefficient R was .133 indicated a weak positive relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination in Mathematics. The adjusted R^2 value of .128 indicated that Continuous Assessment accounted for only 12.8% of the determinant of JSCE performance in

Mathematics. The result of the ANOVA, had the calculated F value = 21.243 was greater than the p-value (.000) at α = 0.05 and degrees of freedom 1 and 396. That is, p-value was .000 < 0.05 proved the fact; the null hypothesis was rejected and the alternate hypothesis retained. This implies that, there was a weak linear relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination in Mathematics for 2017/2018 academic session.

Table 2: Simple Regression analysis of the predictive influence of CA grades on their JSCE performance in Mathematics for 2018/2019 academic session

R	**R^2**	**Adjusted R^2**		**Std. Error of the Estimate**	
.133	.095	.128		8.5722	
Model	SS	DF	MS	F	Sig
Regression	17432.138	1	9631.008	21.243	.000
Residual	29244.261	396	228.533		
Total	**46676.399**	397			

a. Predictors (constant): CA grades in Mathematics
b. Dependent variable: JSCE grades in Mathematics

Table 3 showed the simple regression analysis on the relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination in Mathematics; this produced a correlation coefficient of .177 implying that there exists a positive weak correlation between the grades obtained in CA and JSCE by the students. The adjusted R^2 value of .136 indicated that Continuous Assessment accounted for only 13.6% of the determinant of JSCE performance in Mathematics. The F-value of the Analysis of Variance (ANOVA) obtained from the regression table was F = 11.054 which has a p-value of .000 with 1 and 395 degrees of freedom at .05 level of significance. The implication of this result is that the p-value was not significant hence null hypothesis which stated that; the students' Continuous Assessment grades do not predict their performance in the Junior Secondary Certificate Examination in Mathematics for 2019/2020

academic session was rejected while the alternate was upheld. This result therefore signified that there was a weak linear relationship between grades obtained in Continuous Assessment and Junior Secondary Certificate Examination in Mathematics for 2019/2020 academic session.

Table 3: Simple Regression analysis of the predictive influence of CA grades on their JSCE performance in Mathematics for 2019/2020 academic session

R	R^2	Adjusted R^2	Std. Error of the Estimate		
.177	.136	.121	8.1124		
Model	SS	DF		F	Sig
Regression	11318.225	1	MS	11.054	.000
Residual	25774.116	394	8766.004		
Total	**.37092.341**	**395**	**211.813**		

a. Predictors (constant): CA grades in Mathematics
b. Dependent variable: JSCE grades in Mathematics

Discussion

The essential role of continuous assessment to predict students' academic performance in schools cannot be overemphasized. The roles include: provision of feedback about the learning and teaching process to the school management, provision of objective evidence necessary for decision making, identification of the strength and weakness of teachers, students study habit on the utilization of available learning facilities and so on (Igajah, 2013; Umoh & Agwunobi, 2020; Umoh, Effiom & Igajah, 2021). Gronlund (2006) corroborated that assessment is a continual activity for teachers to improve the quality of instruction and motivate students to learn. From the findings of the recent study; research question one, two and three showed that, the students' performance in the CA and JSCE did not show appreciable correlation. This could likely be due to the fact that the grades obtained by most students during CA exercises are not their true grades because Enukoha (2021) asserted that, continuous assessment scores in most schools in the country lacked merits because a reasonable percentage of teachers are incompetent in teaching and assessing their students. That is, grades obtained by students in their JSCE are product of fraud and dishonesty associated with other

public examinations in the country. It's observed that students buy examination papers; hire people to impersonate as well as lure supervisors to allow them do all manner of malpractices to pass examination with good grades of which is the reason for the poor correlation between grades obtained in CA and JSCE.

The Federal Government aim for implementing continuous assessment was to reinforce the efficacy of teaching and learning; and reduce the over emphasis on examination grades and paper qualification. Contrary to the government aim of effective execution of this programme, is the prevailing large-scale examination leakage and examination malpractice witnessed these days to the detriment of actual performance of the learners. Mkimbili (2018) asserted that in order to attain the competencies in teaching and learning, the method of assessment ought to be dynamic and authentic. That is, the focus should not be on passing the final examinations, but, rather, to attain competencies and ability in solving problems in real life situations. More so, to facilitate learners' acquisition of problem solving skills in the continuous assessment; teachers should specify the learning tasks in a given lesson, administer the assessment for every aspect of competence learned and then utilize feedbacks from evaluation to improve mastery of competencies.

The findings from hypotheses one, two and three which stated that, the students' Continuous Assessment grades do not predict the performance in the Junior Secondary Certificate Examination in Mathematics for 2017/2018, 2018/2019 and 2019/2020 academic sessions were not upheld. That is, from Table 1, 2 and 3 the null hypotheses were rejected because the critical p-values tested at 5% level of significance were all very insignificant. These results have asserted the fact that though CA grades can predict JSCE performance, but with a weak linear relationship. These findings corroborate the results of Benjamin and Habila (2020) who investigated the predictive validity of CA scores on students' performance of JSCE in English Language in Gombe State. The findings of the study showed that there was a weak positive relationship between CA scores and JSCE in English language in 2014/2015 and 2016/2017; it recorded a very weak positive relationship between CA scores and JSCE in 2015/2016 academic session. According to them, JSCE performance of students in English language was predicted from CA scores for 2014/2015

and 2016/2017 academic sessions. More so, it is observed that it wasn't predicted for 2015/2016 academic session. The investigators observed that for the academic year that the predictive validity of CA that was not ascertained was as a result of over adjustment of the students' CA scores.

Furthermore, since grades obtained by students in their Continuous Assessment do not effectively predict Junior Secondary School Certificate Examination performance especially in mathematics at most instances; according to Effiom (2021) Item Response Theory should be adopted in schools whereby teachers are trained on the use and application of this theory. The role of Item Response Theory in educational measurement includes reducing inaccuracy of measurement or lack of objectivity resulting from measurement error in scores obtained by students. The students' true ability in a test could be assessed on every test items which would indicate the students' strength and weakness on the subject areas so that the teachers are guided on appraisal and remedial measures to take to improve the students' academic performance in both internal and public examinations within and outside the State.

Conclusion

It is basically expected that there should be a positive correlation between Continuous Assessment grades and Junior Secondary Certificate Examination performance in Mathematics. In the recent study, CA grades and JSCE performance did not show appreciable correlation because the linear values for the three academic sessions gave weak relationships. More so, the p-values tested at 5% level of significance from the three hypotheses were not significant. From the foregoing, it is presumed that CA scores could not validly as generally expected establish a strong linear relationship nor predict effectively grades obtained by students in Continuous Assessment on Junior Secondary Certificate Examination; these may be due to: inflation of scores by teachers, lack of standardization in administration of the assessments within the State, lack of psychometric properties in the Continuous Assessment and other variables which may have contributed negatively to the Mathematics performance of the students in the Junior Secondary Certificate

Examination in Cross River State, especially in 2017/2018, 2018/2019 and 2019/2021 academic sessions of the recent study.

Recommendations for policy direction

The following recommendations based on the findings of the study are offered for to guide policy directions:

1). Continuous assessment scores should not be inflated so that it could be utilized for effective prediction in public examinations.

2). There should be uniformity and standardization in administering continuous assessment across the schools in the State.

3). Incompetence in the operation of continuous assessment by teachers should be checked through training of the teachers on how to administer continuous assessment.

4). Schools should adopt the Item Response Theory and train teachers on the application of the theory so that teachers can identify the child's strength and weakness on test items and recommend remedial measures to improve on the students' performance.

5). The State Ministry of Education should ensure that teachers cover the curriculum and provide standard and hitch-free examination across the State.

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