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Research Paper

Predictive validity of continuous assessment scores on students performance in mathematics in some selected states in the South-West Nigeria

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Abbreviations: CA, Continuous assessment; **CAS,** continuous assessment scores; **AACA,** actual aggregate continuous assessment scores; **MACA,** moderated aggregate continuous assessment scores; **NECO,** National Examinations Council; **WASC,** West Africa School Certificate; **JAMB,** Joint Admission and Matriculation Board; **WASSCE,** West African Secondary School Certificate Examination.

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Abstract. This paper examined the predictive validity to determine the relationship and effects of Continuous Assessment Scores (CA) on the performance of students who sat for the Senior School Certificate Examination conducted by National Examinations Council (NECO) using June/July 2010 Senior School Certificate Examination (SSCE) as case study. Scores which were obtained from NECO had been transformed and trial-tested for psychometric properties. Six research questions were generated giving rise to six hypotheses which were tested at $\alpha = 0.05$ level of significance. The data used was analyzed using descriptive statistics of means, standard deviation and inferential statistics of regression analysis. We found that there was a positive but significant influence of Actual Aggregate Continuous Assessment (AACA) and Examination Scores on the Final Score. Also, there was a positive and significant influence of Moderated Aggregate Continuous Assessment Scores (MACA) and Examination Scores on Final Scores. We also found that AACA and Examinations Scores combined had the ability to predict the Final Grade as well as the combination of both MACA and Examination Scores. AACA and Examination score had positive and significant effect on Final Scores as well as MACA and Examination Scores. We however found that AACA and Examination Score had negative effect on Final Grade as well as MACA and Examination Scores combined. These findings showed that though CA Scores yielded positive influences on the Final Scores/Final Grade, the Moderated version yielded negative influence and effect, thus lowering the Grade. By implication, the Moderated CA Scores (MACA) and Final Scores were negatively correlated while the CA and Final Scores/Grade were positively correlated. This indicates some problems. In other words, the two variables CA and MACA (both) should either be positively or negatively correlated with final Scores/Grade. Based on the above findings, we cannot use Continuous Assessment (CA) Scores alone to predict students' performance in mathematics and also that principals should be encouraged to submit the actual CA worth of the students. The stakeholders in our schools should be cautioned and if there is any adjustment to CA it should be done statistically as being done by NECO.

Keywords: Examination scores, final scores, final grade.

INTRODUCTION

Glaser (1960) categorized prediction into 3 types, namely: classification, selection and guidance. Classification is the assignment of the individual into the category to which he/she belongs. Selection involves the categorization of individuals in away that indicates the probability of success on a desired task, while guidance provides information regarding the abilities, interest and the chance of success in reaching various goals. On the

other hand, Cronbach (1971) stated that "validation" is checking of test scores against some other "criterion". Essentially, predictive validity is concerned with the usefulness of test scores in predicting future performances, Joint Admission and Matriculation Board (JAMB) (2009). Mathematics, according to Kolawole and Udoh (2012), is the tool in the development of science-based knowledge such as technology, industry and even for sound analytical reasoning in daily living in this communication age. Nwadiae (2010) reported that 75% of the total candidates who sat for West African Senior Secondary School Certificate Examination (WASSSCE) May/June 2012 failed mathematics and English language. He further gave the breakdown for those who scored credit in mathematics alone as 41.50%, while those credited in the previous years are 25.99% in 2009 and 13.76% in 2008.

Ojerinde and Falayajo (1984) asserted that continuous (school based) assessment CA is among others, systematic and comprehensive. Okonkwo (2003) argues that such an assessment should yield the measures of the students' achievement. While Okedara (1980) found a positive correlation between the CA and end of course (certificate) Examination Grades, Ali and Akibue (1988) found the CA scores of their subjects not sufficiently reliable. Ojerinde (1974) found that many problems are embedded in the approach of using scores or grade for assessing academic performance, for example teachers may be biased. But Alonge (1983) contended that Mock Mathematics Examination helped in predicting academic performance of students in WASC Examination. CA is the assessment strategy for the educational evaluation of student's achievement in teaching-learning situations in the Nigerian school system. Ojerinde (2004) stressed the need to integrate the behavior of school based scores, that is, CA scores sent to examination bodies into the results of schools and also recalled that Nigerian Policy on Education stipulates the use of school based scores as a component of certification. At the Secondary School level, school based assessment is given 30% in the certification process. Since 2001, NECO which is the National Examinations Outfit established in 1999 by the Federal Government to conduct examinations in parallel with West African Examinations Council (WAEC) has been providing in service training for teachers to participate in its Senior School Assessment/Certification Programme during which NECO share with the participating teachers the very concept of the CA, the rationale and challenges of its implementation and the appropriate approach to such an implementation. On its part, NECO uses statistical approach to moderate the CA scores which are (school- based assessment) submitted to NECO by the Schools and is based upon 30 marks which are generated from SSS I to SSS III before incorporating them into the certification grades (JAMB, 2004). The raw scores (CA) submitted by the schools are aggregated by NECO to obtain AACA, that is, the Actual Aggregate of Continuous Assessment Scores. However, NECO moderates the AACA scores statistically to arrive at MACA, that is, Moderated Aggregate of the Continuous Assessment which is finally incorporated into the certification scores (Final Scores) which is the totality of CA (MACA) and Examination Scores, that is, CA 30% plus Examination Scores 70% = Final Scores 100%. This gives cause to doubt the validity of assessment in the school system.

Given the importance of mathematics as an indispensable means by which science expresses, formulates, continues and communicates itself (Bridgeman, 2002) vis-à-vis the usefulness of CA in the end-of-course assessment procedure, this study is therefore designed to find whether CA is a predictor of student's performance in Mathematics.

Statement of the problem

The problem of the study is the poor students' performance in mathematics in NECO examinations and the factor(s) responsible. Consequently, the study was designed to see whether CA is an excellent predictor of performance in mathematics. This is done by investigating whether there is any effect and any influence of the AACA returned by the schools in combination with certificate Examination Scores on the Final Scores. Similarly, it was to look at the influence and effect of the combined MACA and Examination Scores on the Final Scores/Grade of the students. Hence the following questions were raised for the study.

Research questions

The following research questions are consequently generated:

1. Is there any influence of AACA and examination scores on final scores in mathematics?
2. Is there any effect of AACA and examination scores on the final scores in mathematics?
3. Is there any influence of AACA and examination scores on the final grade in mathematics?
4. Is there any influence of MACA and examination scores on final scores in mathematics?
5. Is there any effect of MACA and examination score on the final scores in mathematics?
6. Is there any influence of MACA and examination scores on the final grade in mathematics?

Research hypotheses

Based on the questions raised, the following hypotheses were postulated:

1. There is no significant influence of AACA and exami-

Table 1. Regression Analysis of AACA and Examination Scores on Final Scores in Mathematics.

Variables	R	R^2	F-value	R^2 change (AACA)	R^2 change exam scores
AACA	0.362	0.131*	272.796*		
Examination scores	0.951	0.905*	17260.858* (1,180)	0.799*	0.025*
AACA + Examination scores	0.964	0.930*	11957.362* (2,1804)		

* P < 0.05

nation scores on the final scores in mathematics.
2. There is no significant effect of AACA and examination scores on final scores in mathematics
3. There is no significant influence of AACA and examination scores on the final grade in mathematics.
4. There is no significant influence of MACA and examination scores on the final scores in mathematics.
5. There is no significant effect of MACA and examination scores on the final scores in mathematics.
6. There is no significant influence of MACA and examination scores on the final grade in mathematics.

METHODOLOGY

The study adopted ex-post facto design of the regression design. The population consists of 245,935 students of both public and private secondary schools in South-West Nigeria who sat for June/July 2010 Senior School Certificate Examination conducted by NECO. The sample is comprised of 1807 students out of the population of 245,935 which were drawn randomly from Lagos, Oyo and Ekiti States using multistage random sampling techniques. The instrument used to elicit information from NECO was tagged: Format of schedules used to collect information from NECO. The test items used by NECO were trial tested for psychometric properties. The CA scores returned by the schools to the NECO were standardized, hence face-validity and content-validity were ensured. Data used were analyzed using descriptive statistics of means, standard deviation and inferential statistics of regression analysis.

RESULTS

The study found the mean scores of CASS vary between 66.16 (SS II) and 66.36 (SS I). The standard deviation varies between 7.495 (SS II) and 8.917 (SS I) with a range of 1.422. AACA had a minimum of 13.20 and maximum of 28.73 out of 30. MACA had a minimum of 11.13 and maximum of 26.98 and standard deviation of 3.265. CASS standard deviation improved over the classes, that is, 8.917 in SS I, 8.442 in SS II, and 7.495 in SS III.

Hypothesis 1

There is no significant influence of AACA and Examination Scores on the Final Scores in Mathematics.

A simultaneous multiple regression analysis was carried out to assess the combined influence of AACA and Examination Scores on Final Scores.

Table 1 shows that when performance in AACA is combined with the performance in Examination Scores the ability of the respective test scores to predict performance of students in Final Scores got enhanced significantly. The combined influence of AACA and Examination Scores accounted for about 93% in the variation of Final Scores. Similarly, the unique contribution of AACA and Examination Scores was 13 and 91%, respectively. The R of 0.964 and multiple R of 0.930 with 2 and 1804 degrees of freedom was significant at P < 0.05 level. The F-value (11957.362) was also significant. Also, the R^2 change, due to the addition of AACA Scores and Examination Scores, were 79.7 and 2.5%, respectively. There is a nearly perfect or extremely high relation between AACA, Examination Scores and Final Scores. In other words, there is significant positive influence of AACA and Examination Scores on the Final Scores. This shows a positive influence. Hence the null hypothesis is rejected.

Hypothesis 2

There is no significant effect of AACA and Examination Scores on the Final Scores.

A simultaneous regression analysis was carried out to assess the combined effect of AACA and Examination Scores on the Final Scores in Mathematics.

The regression equation is given by:

Final score = -4.060 + .199AACA + .810Exam Score

Table 2 shows that both predicators (AACA and Examination Scores) yielded significant beta weights (B_{AACA} = 0.199*, $B_{EXAM\ SCORE}$ = 0.810*, P < .0.05) in each case. The effect of AACA (t = 25.117*, p < 0.05) and Examination Scores (t = 143.311*, P < 0.05) on Final Scores were positive and significant at 0.05 level in each case. In other word, there is a significant effect of AACA and Examination Score on the Final Scores. Examinations Scores is the better predictor of the Final Score. The result also shows external influence (such as the inflation of CA, adjustment of the CA and other school variables, etc) contributed negatively to the performance

Table 2. Regression analysis showing the effect of AACA and Examination Scores on the Final Scores in Mathematics.

Model	B	Standard error	Beta	T	Sig	F value
Constant	-4.060	0.544		-7.469*	.000	
AACA	0.199*	0.0008	0.161	25.117*	.000	11957.362*
Examination score	0.810*	0.006	0.916	143.311*	.000	

*P < 0.05

Table 3. Regression Analysis of AACA and Examination Scores with Final Grade.

Variable	R	R^2	F-value	R^2 Change (AACA)	R^2 change (exam score)
AACA	0.466*	0.217*	498.855*		
Exam score	0.833*	0.693*	4075.923*	0.582	.086
AACA + Exam score	0.882*	0.779*	3170.248* (2,1801)		

*P < 0.05

Table 4. Regression analysis of MACA and Examination Scores with Final Scores in Mathematics.

Variable	R	R^2	F-value	R^2 Change (MACA)	R^2 change (exam score)
MACA	0.269	0.072*	141.025* (1,1805)		
Exam score	0.951*	0.905*	17260.858* (1,1805)	0.866*	0.033*
MACA + Exam score	0.969	0.938	13689.495* (1,1804)		

*P < 0.05

of the students in the Final Scores. Hence, the null hypothesis is rejected.

Hypothesis 3

There is no significant influence of AACA and Examination Scores on Final Grade in Mathematics.

A simultaneous multiple regression analysis was carried out to assess the combined influence of AACA and Examination Scores on Final Grade.

Table 3 shows that when AACA is combined with performance in the Examination Scores, the ability of the respective test scores to predict performance in Final Grade got enhanced significantly. AACA and Examination Scores accounted for about 77.9% in the variance of the Final Grade with unique contribution of 21.7 and 69.3% respectively giving rise to the regression equation.

Final grade = 15.910 - .0.55AACA + .103Exam Score

The R^2 value of 0.582 showed that 58.2% of the variation was jointly explained by the AACA and Examination Scores. The R^2 change due to the addition of AACA and Examination Scores were 58.2 and 8.6% respectively, that is, the addition of 58.2% variation in Final Grade was as a result of the addition of AACA Scores and 8.6% by the addition of Examination Scores. Hence, while AACA introduced negative change, Examination Scores has positive change. R, R^2 and F-value of .882, .779 and 3170.248 respectively were found to be significant at 0.05 level. The R^2 of .779 shows that the two predictors together significantly predicted the Final Grade. In other words, there is a significant influence of AACA and Examination Scores on Final Grade. The null hypothesis was thereby rejected at 0.05 level.

Hypothesis 4

There is no significant influence of MACA and Examination scores on Final Scores.

A simultaneous multiple regression analysis was carried out to assess the combined influence of MACA and Examination Scores on Final Scores.

Table 4 shows that when performance in the MACA is combined with performance in Examination Scores, the ability of the respective test scores to predict performance in the Final Scores got influenced significantly. The combined influence of MACA and Examination Scores accounted for about 93.8% in the variance of Final Scores. Also, the unique contribution of MACA and Exam Scores were 7.2 and 90.5% respectively to the Final Scores. The R of 0.969 and multiple R of 0.938 with 1 and 1804 degrees of freedom

Table 5. Summary of regression analysis showing the effect of MACA and Exam Scores on Final Scores.

Model	B	Std. error	Beta	T	Sig. T	F. value
Constant	0.415	0.354		1.172	.241	
MACA	0.157*	0.005	0.182	30.965*	.000	13689.495*
Exam Scores	0.826*	0.005	0.935	158.947*	.000	

* P < 0.05

Table 6. Summary of regression analysis of MACA and Exam Scores with Final Grade in Mathematics.

Variable	R	R^2	F-value	R^2 change (MACA)	R^2 change (Exam Score)
MACA	0.338	0.114*	232.372* (1,1802)		
Exam score	0.833	0.693*	4075.923* (1,1802)	0.648	0.069
MACA + Exam score	0.873	0.762*	2883.362* (2,1801)		

* P < 0.05

was significant at P < 0.05 level. The F-value was also significant. Also, the R^2 change due to the addition of MACA and Examination Scores were 86.6 and 3.3%, respectively. The combined influence of MACA and Examination Scores was 96.9% in the variance of the Final Scores. This was significant in each case. The regression equation is given as:

Final Scores = 0.415 + 0.157MACA + 0.826Exam Scores

The R and R^2 due to the addition of MACA and Examination Scores were 0.969 and 0.938 respectively. The F-value (13689.495) was statistically significant at 0.05 level. It implies that the two variables taken together significantly predicted the Final Scores. With R^2 value of 0.938, 93.8% of the variation was jointly explained by MACA Scores and Exam Scores.
Hence, there is a nearly perfect or extremely high relationship between MACA, Exam Scores and Final Scores. This shows a positive influence. The null hypothesis is rejected.

Hypothesis 5

There is no significant effect of MACA and Exam Scores on Final Scores in Mathematics.

A simultaneous multiple regression analysis was carried out to assess the combined effect of MACA and Examination Scores on Final Scores.

Table 5 shows that MACA and Exam Scores yielded a significant positive beta weight in each case (B_{MACA} = .157*, $B_{EXAM\ SCORES}$ = .826*, P < 0.05). Exam Scores was a better predictor of Final Scores. The regression equation is given by:

Final Scores = 0.415 + 0.157 MACA + 0.826 Examination Scores

This shows that external influence (e.g school variable) aside MACA and Exam Scores contributed positively to the Final Scores. In other words, there is a significant effect of MACA and Exam Scores, on the Final Scores. The null hypothesis is therefore rejected as 5% level of significance.

Hypothesis 6

There is no significant influence of MACA and Exam Scores on the Final Grade in Mathematics.

A simultaneous multiple regression analysis was carried out to assess the combined influence of MACA and Examination Scores on Final Grade in Mathematics.

Table 6 shows that the predictive ability of the combined variables (MACA and Exam Scores) was enhanced significantly. The combined influence of MACA and Exam Scores on the Final Grade was 76.2% of explained variance. Similarly, the R, R^2 and F-value of 0.873, 0.762 and 2883.362 respectively were found to be highly significant at 0.05 level. It implies that the two variables jointly predicted the Final Grade. The regression equation is:

Final Grade = 14.215 - 0.034MACA - 0.108Exam Scores

The R^2 value of 0.762 shows that 76.2% of the variation in Final Grade was jointly explained by MACA and Exam Scores. The individual contribution of the predictors (MACA and Exam Scores) was 11.4 and 69.3%, respectively. The R^2 change, due to the addition of MACA was 0.648 while that of Exam Scores was 0.069. This implies that the addition of 64.8% of variation in Final Grade was accounted for by the addition of MACA, while 6.9% variation in the Final Grade was also obtained resulting from the addition of Exam Scores. In other words, there is a significant but negative influence of MACA

and Exam scores on the Final Grade. The null hypothesis is therefore rejected at 5% level of significance.

FINDINGS AND DISCUSSION

This findings of this study showed that there was a significant, positive but low influence of AACA on the Final Score (13.1%) of the students. Equally, we found that AACA in combination with Examination Scores had a positive and significant effect on the Final Scores. Also AACA was found to have positive and significant influence on Final Grade (21.9%).

The findings also confirmed that MACA had an influence of 7.2% on the Final Scores. The difference of (13.1 - 7.2) 5.9% was as a result of the moderation procedure. Also, MACA was found to have significant but negative effect on the Final Scores and Final Grade as well. It contributed about 11.4% as influence of the Final Grade. The wide gap of (21.7 - 11.4) 10.3% (influence) is as a result of moderation. These findings showed that though CA Scores yielded positive influences on the Final Scores/Final Grade, the moderated version yielded negative influence and effect, thus lowering the Grade. By implication, the Moderated CA Scores (MACA) and Final Scores were negatively correlated while the CA and Final Scores/Grade were positively correlated. This indicates some problems. In other words the two variables CA and MACA (both) should either be positively or negatively correlated with Final Scores/Grade. The findings agreed with Ojerinde (1974) who stated that many problems are embedded in the approach of using Score or Grade for assessing academic performance, one of which is that teachers may be biased. It was obvious that the Scores returned were inflated (biased). This however was not in consonance with Alonge (1983) who investigated the predictive validity of Mock Mathematics Examination in WASC examination and came out with the conclusion that the Mock Mathematics Examination helped significantly in predicting academic performance of students in WASC Examination. However, the finding agreed with JAMB (2004) which asserted that the low validity of assessment in many state/private schools would be due to the authorities of the schools on which parents have mounted increased pressure to admit beyond the designed capacities of the schools facilities leading to over-crowding. Such over-crowding, according to JAMB 2004, cannot but hamper the quality of assessment among other things. Such a low validity of assessment could lead to loss of confidence in the assessment in schools and could discourage learning. The stakeholders in our schools should be cautioned and if here is any adjustment to CA it should be done statistically as being done by NECO to avoid biasedness.

CONCLUSION AND RECOMMENDATION

We examined the influence and effects of AACA and MACA in determining the Predictive Validity of Continuous Assessment Scores on Students Performance in Mathematics and found that AACA had an influence of 13.1% on the Final Scores. Second, it had significant and positive effect on it and third, it had 21.7% by effect, on the Final Grade. On the other hand, MACA had 7.2% influence on the Final Scores and negative but significant effect on the Final Grade. This is not realizing the full potentials of CA which is probably as a result of the ways the CA Scores are being generated. There is therefore the need to continue to expose the teachers to in service training on skills of tests and measurement courses. This will go a long way in achieving the stated objective of CA in the Final Assessment of Students. The school authorities should endeavor to submit the actual CA scores of students and if a case of adjustment is necessary, they should use statistical models such as linear transformation and others that would be used without bias in favour or against any student. Though the low influence of the CA was found, it is recommended that CA should still be included in the final certification process, since it is formative, summative and evaluative in nature.

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