PRACTICAL PERFORMANCE AS A PREDICTOR OF THEORY IN BOTSWANA JUNIOR CERTIFICATE AGRICULTURE

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Abstract
Students' performance has shown a decline in several subjects in Botswana schools, while in Agricultural education, the decline has become consistent at all levels of education. This study assessed the predictive validity of students' performance in practical based assessments and their performance in theory, a national standardized graded examination. A quantitative correlational design was adopted to assess the relationship between students' performance in practical and their performance in theory from (N =156239) students who sat for 2014-2017 Final Junior Certificate Examinations in Agriculture. A simple regression analysis results showed that students' performance in practicals significantly predicted their performance in theory showing that students' performance in practical examinations play an important role in predicting their performance in theory. Findings of this study can be used as a point of reference by the Ministry of Basic Education to revisit the assessment of practical subjects such as Agriculture with a view to align them with the national long-term vision, goals and strategies.

Keywords: *Predictive Validity; Students Performance; Practical Examination; Theory Examination; Agriculture Final Examinations.*

Introduction

Nations, states and governments are concerned about the outcomes of students' learning based on the efforts they have put in to ensure universalization of basic education (Masole, 2011). However, the continued decline in students' academic performance has become a global concern for most educational institutions as it hinders the execution of their educational missions and goals (Al-Zoubi & Younes, 2015). Past research investigating decline in student academic performance has been conducted in most African countries where concerns were reported. In Ghana for instance, Adane (2013) and Etsey (2005) found that poor academic performance continues to perpetuity at primary and junior high schools regardless of the government's effort to provide universal basic education to all citizens. Similar concerns were identified in Kenya as research findings from Mbungua, Kibet, Muthaa, and Nkonke (2012) and Wanjiru (2013) revealed persistent declining academic performance of students as experienced in different districts of the country.

Similarly, in Botswana, Sibanda, Hulela, and Tselaesele (2016) reported that students' academic performance has shown some decline in many school subjects while in Agricultural education, the decline has become consistent at all levels of education. This problem has become a government and national concern. This problem is making the quality of education questionable given Botswana educational policies that emphasize quality and relevant education. Moreover, the implementation of school based assessments such as practical assessment as a part of the final examination has proved to be problematic as teachers found the marking criteria for practical tests to be subjective and difficult to implement to an extent that most teachers created and used their own (Molelekwa, 2012). This has raised serious concerns from Botswana Examinations Council about the reliability and validity of school based assessment that contribute to the final grades of students (Isaiah & Isaiah, 2017). For instance, BEC has observed that since 2010, there has been a major grade inflation of Agriculture practical test scores submitted by different schools (Hulela, 2017). Agriculture is a fundamental practical subject and majority of the people in rural areas of Botswana rely on Agricultural activities as a source of livelihood; hence, it was imperative to raise concern when students fail the subject (Sibanda, et al.). Hulela and Miller (2003), indicated that Agriculture was introduced into schools for the purpose of preparing students for diverse career opportunities. Therefore student's low performance in Agriculture can have major implications on Botswana's long term plan to diversify its economy through the required skill students should have acquired to be competitive in the labor place. Based on this, this study was meant to ascertain the predictive validity of students' performance in practical examination on their performance in theory for Junior Certificate Examinations in Agriculture.

Regardless of these shortcomings, few studies to assess the predictive validity of students' performance in practicals against their performance in theory in Agriculture final examinations have predominantly focused on Botswana senior secondary schools (Isaiah & Isaiah 2017; Thobega & Masole, 2008). None of the research studies has focused on student performance at junior secondary schools making it difficult to have a clearer understanding of the nature and magnitude of the predictive value of student performance in practical assessment against their performance in theory especially at Junior Certificate level. This study endeavored to focus on the predictive validity of students' performance in practical based assessments which are predominantly school based against their performance in theory, a

national standardized graded examination. This study is critical bearing in mind that BEC has criticized teachers for inflating practical test scores on yearly basis (Hulela, 2017).

Theoretical frameworks

The theoretical concept of validity has been developed over time as indicated by the periodical revisions on standards in educational testing published by the American Psychological Association, the National Council for Measurement in Education and the American Educational Research Association (Spiteri, 2013). Validity refers to the degree to which an assessment measures what it purports to measure and how well it serves the intended purposes (Herman & Choi, 2012). Generally, assessments are meant measure the skills that students attained from teaching. For a test to be worthy, it ought to have satisfactory validity evidence (Kubiszyn & Borich, 2013). Importantly, a test itself cannot be considered valid unless evidence of validity has been established in the context of its specific use. Therefore, if a test is to be used for any kind of decision making, or if the test information is to have any use, some validity evidence about the test should established. Predictive validity refers to how well scores or grades from a criterion test predicts some future performance of the examinees. Kerlinger and Lee (2000) argued that when one test predicts success or failure of students from academic aptitude measures, one is concerned with its predictive criterion related validity. The predictive validity of a test is determined by administering a test to a group of students, then measuring the students on whatever the test is supposed to predict after a period has passed (Kubiszyn & Borich, 2013). The two sets of scores are then correlated, and the coefficient that is produced is called predictive validity coefficients. The predictive validity of success in examinations has become one of the most topical debates in the education system.

Purpose of the study

This study therefore endeavored to assess the predictive validity of students' performance in practical based assessments which are predominantly school based against their performance in theory, in a national standardized graded examination. Specifically, the study was meant to find out if students' performance in practical examination can validly predict their performance in theory final Junior Certificate Examinations in Agriculture. The following research question was addressed.

What has been the predictive validity of student performance in practicals and their performance in theory in Agriculture Junior Certificate Final Examination between years 2014-2017?

Literature Review

Many factors are said to contribute to the poor performance of students in their final national examinations. Among others, is the fact that teacher made assessments are of poor quality in the sense that they lack psychometrics properties such as difficulty, discrimination, fairness, reliability and validity. As assessors, teachers are said to spend at least one third to half of their time on assessment related activities (Sikka, Nath & Cohen, 2007). As such, teacher made assessments or school-based assessments make part of the final high-stake tests or public examinations which are used for certification, selection and for progression of students in different education systems around the globe. Hence such assessments are very crucial. According to Isaiah and Isaiah (2017) teachers' classroom assessment of practical subjects like agriculture, form an important and integral part of their final national examinations in such

subjects. Despite their importance, teacher made assessments are said to be of low quality as they have been found to lack both validity and reliability and other key psychometric characteristics (Sikka, et al., 2007). These can be attributed to the fact that teacher training institutions do not expose teachers to assessment issues during their pre-service and post-service training. According to Nenty (1997) some teachers training institutions in Africa do not offer courses that impart assessment skills at all, while some make such courses optional as if assessment is an optional duty of the classroom teacher. Furthermore, there is a concern that students get good grades in teacher made assessments but fail to get the same in final national examinations (Hulela, 2017).

Practical examinations' predictive validity on final examinations

Past research to assess predictive validity of students' performance on practicals and their performance on theory on a variety of subjects has been conducted. For instance, Achor, Agogo, and Orokpo (2011), carried out a study to investigate if students' performance in a test of practical knowledge in Chemistry does significantly predict their performance in MOCK-SSCE Chemistry theory examination. Using multiple regression analysis, the result showed that students' performance in a test of practical knowledge in chemistry does not significantly predict their performance in MOCK-SSCE Chemistry theory examination. In another study Adewumi and Monisola (2013), investigated Continuous Assessment, Mock results and gender as predictors of academic performance in WASSCE and NECO Examinations. Results in this study revealed that continuous assessment was a valid predictor of WASSCE students' academic performance in chemistry. Olutola, Daramola, and Bamidele (2016), investigated the comparative effects of practicals and alternative to practical methods on students' academic performance in Biology in Ilorin, Nigeria. The researcher hypothesized that there is no significant effect of practical method on secondary school students' performance in Biology, Analysis of Covariance (ANCOVA) statistics was employed. The findings of the study revealed a significant effect of practical methods on secondary school students' performance in Biology. This showed that practical methods are an important factor in predicting student performance in Biology in secondary school. Usman (2000), studied the relationship between students' performance in practical activities and their academic achievements in integrated science using NISTEP mode of teaching. A sample of 100 participants was selected and the Pearson's product moment correlation coefficient was used to analyze data. It was found that there was a significant high positive relationship between students' performance in practical activity and their academic achievement in integrated science when taught using NISTEP method. Another study, aimed at finding the correlation that exists between students' theoretical and practical performance in computer application course was conducted by Galadanci and Mukhtar (2017). In analyzing the data, Pearson Product Moment Correlation was used. These results showed that there is a statistically significant and strong positive relationship between students' theoretical and practical scores as a result of which the null hypotheses were rejected.

In Botswana, Isaiah and Isaiah (2017) conducted a study to find out the extent to which classroom assessments predicted 2008 BGCSE Agriculture finals. They hypothesized that practical test grades significantly predicted 2008 BGCSE students' Agriculture final grades. The other hypothesis was that forecast grades significantly predicted 2008 (BGCSE) students' Agriculture final grades. It was revealed that when practical test grades were analyzed on their own using simple regression to predict 2008 BGCSE final grades, they were significant predictors of BGCSE final grades at 0.05 alpha level.

However, practical grades explained only 13% of the variation in BGCSE final grades. Forecast grades were however found to be good predictors explaining 46% of BGCSE final grades, which was also significant. The study further revealed that practical grades and forecast grades were put together, and they explained 48% of the variance in 2008 BGCSE Agriculture final grades. The results for forecast were significant while it was insignificant for practical test grades at 0.05 alpha level. While Thobega and Masole (2008) conducted a descriptive-correlational study to determine which of the component 1 (multiple choice), component 2 (structured questions), and component 3 (practical) of the Botswana General Certificate of Secondary Education Agriculture can be used to predict students' forecast grades. The study showed that all the three components significantly predicted forecast grades. However, structured questions contributed the largest percentage of the variability followed by multiple-choice while practical scores shared the smallest variability with forecast scores. Thobega and Masole (2008), also found low positive and significant correlation, between multiple-choice and practical scores, and between structured questions and practical scores.

Collectively these past research studies showed some inconsistencies in their findings. Some found practical examinations to be a good predictor of final examinations, while others found it to be poor a predictor of final examination. Moreover, the past research studies, especially in Botswana studied population selected from senior secondary schools, hence there is a gap in using a population wide from junior secondary schools. Furthermore, in Botswana no scholar has studied the predictive validity of students' performance in practicals and their performance in theory examination. Rather, past researchers have looked at either the predictive validity of students' performance in practicals and their performance in the final examination grades, or the predictive validity of forecast grades on final examination grades. The final examination grade is a composite score made up of practical, forecast and theory grades. On the other hand, theory examination is a score from multiple- choice (paper 1), and structured questions (paper 2).

Methodology
Research design
The study used a correlational design to assess the predictive validity of students' performance in practical against their performance in theory for Junior Certificate Agriculture Final Examinations. A correlational design was considered most suitable and adequate to address this study's stated objectives as well as the proposed research questions. By selecting a research design most suitable to answer the research questions, the research was therefore able to control variances due to error (Kerlinger & Lee, 2000).

Population of the study
The targeted population for this study comprised of scores of all students from government junior secondary schools who sat for final practical and theory Junior Certificate Examinations in Agriculture between (2014- 2017) in Botswana.

Sampling
The data that was used in this study was students' scores in practical examination and the final theory JCE in Agriculture which was extracted from Botswana Examination Council's database. Hence, no specific sampling method was used as all the scores for both the practical and final theory JCE

Agriculture between the years 2014 through 2017 were included. The sample size include the 2014 students ($n =38353$), 2015 ($n = 39671$), 2016 ($n= 39511$), and 2017 ($n = 38704$) making a total population sample size of ($N= 156239$) of students' scores in JCE Agriculture.

Measure

Data obtained from students' academic records were retrieved from BEC's database. In this regard, both the practical examinations and final theory JCE scores were obtained from BEC database. At Junior Secondary level, Agriculture is assessed through three components, which are multiple choice questions (Paper 1), structured response questions (Paper 2), and center-based practical's examination (Paper 3). Component one contributes 35% , component two 40%; while component three accounts only for 25% of the final examination grade (Botswana Examinations Council, 2013). Components one and two constitute the theory part of the final JCE while component three is the practical part. Grading for theory part of the JCE is conducted at National level through the coordination of the Botswana Examination Council, while grading for component three is center-based practical's examination (Paper 3) graded at school level by teachers who teach agriculture but moderated by BEC.

Data collection procedures

Practical and theory Agriculture Junior Certificate Examination results were obtained from BEC. Students' scores in paper 3, paper 2 and paper 1 from years 2014 to 2017 were collected in Microsoft Excel form using a re-writable compact disc then transferred into Social Science (SPSS) version 24 for analysis.

Ethical Considerations and entering research setting

Before data collection, the researchers sought ethical clearance from University of Botswana's Internal Review Board. After obtaining ethical clearance the researchers requested for permission to conduct the study from the Ministry of Basic Education's Department of Educational Planning and Research Services. The Ministry of Basic Education approval letter was then used to request for permission to use students' scores from Botswana Examinations Council.

Potential harms and confidentiality

Due to the nature of data collected, anonymity can be guaranteed as students' identifiers were not obtained from the BEC data base. Since collected data is electronic it has been password protected. Data presented in manuscripts and other formats are not likely to identify the students who sat for the examination.

Potential benefits

There are no direct benefits to study participant. We hope the study will lead to increased understanding of how students' performance in practical part of agriculture can be used to predict their performance in theory hence this could help inform educational practice and policy in Botswana.

Data analysis

Simple regression was computed to assess the association between the independent variable (practical examinations score) and the dependent variable (theory examinations score). According to Seltman (2015), when examining the relationship between a numerical outcome and a single quantitative explanatory variable, simple linear regression is the most commonly considered analysis method. Field

(2009), explains that simple regression is relevant for predicting an outcome variable from one predictor variable hence, simple regression was relevant for assessing the predictive validity of students' performance in practical against their performance in theory in Junior Certificate Agriculture Final Examinations in Botswana. The regression equation below guided the analysis.

$Y' = \beta 0 + \beta 1 X 1$

Where

Y' = the predicted value of the dependent variable, (Performance in Theory)

$\beta 0$ = Performance in Theory – intercept or prediction value of performance in theory when performance in practical = 0

$\beta 1$ = *Slope* of regression line; the change in the predicted value of performance in theory for every 1-unit change in performance in practical …Also called regression coefficient or regression weight.

b = changes in performance in Theory

changes in performance in Practical

Results

This study sought to establish whether practical scores awarded by Agriculture teachers were valid in predicting the final theory score of the student in the subject. Before commencing with the analysis, assumptions of simple regression were examined to ensure that they are not violated. Assumptions of normality, homoscedasticity and independence of errors were assessed using the residual plot. The assumption of normality was met as most of the residuals were closely clustered around zero and differences much greater than zero happened only occasionally. Moreover, the assumption of independence was also met as no clear patterns formed in the residuals since each value of the outcome variable came from a separate entity. Homoscedasticity was met as there was equal variance in errors at every point along the X axis. Scores on both the predictor and the predicted variables are continuous; hence, they were measured on an interval or ratio scale. All the assumptions were met satisfactorily making it possible to compute a simple regression analysis.

The simple regression results showed that in predicting students' performance in theory examinations, their performance in practical examinations explained only 7% of the total variance for the year 2014. For the 2015, 2016 and 2017 data, the results revealed that the models only accounted for 9% , 8% and 9% of the total variance in students' performance in the theory examination respectively (see Table 1).

The results further showed some positive slopes an indication that when students performance in practical examination increased then their performance in theory also increased. In the year 2014, results showed some weak relationship between students' performance in practical examination and their performance in theory, β = .27, *t* = 53.99, *p* = .001. Similar pattern of results were shown in 2015, 2016 and 2017 respectively (see Table 1). Even though there were weak relationship between students' performance in practical and their performance in theory, results showed that performance in practical examination validly predicted performance in theory examination in Agriculture JCE. The positive slopes across the years showed that when students' performance in practical examination increased, their performance in theory examination also increased.

Table 1

Summary of simple regression analysis for 2014 through 2017 JCE Agriculture

Year	Predictor	R^2	t	B(SE)	B
2014	Practical	.071*	53.99	.46(.009)	.27*
2015	Practical	.094*	64.00	.67 (.010)	.31*
2016	Practical	.079*	58.05	.68 (.012)	.28*
2017	Practical	.086*	60.45	.78 (.013)	.29*

Note: *$p < .05$; Dependent variable: *Performance in Theory Examination*

Discussion

The research question that guided this study was what has been the predictive validity of student performance in practicals and their performance in theory in Agriculture Junior Certificate Final Examination between years 2014-2017? Findings showed that for the years between (2014-2017) students' performance in practical significantly predicted their performance in theory in Agriculture Junior Certificate final examinations. Findings across the four years showed some weak, positive and significant relationship between students' performance in practical examinations and their performance in theory. Though practical examination accounted for small performance of students in theory, the prediction was significant. In other words, practical examinations contributed positively to the performance of students in the theory examination. The weak relationship between students' performance in practical examination and their performance in the theory examination, could be associated with the fact that the weighting given to the practical component of the examination is very small (25%) compared to the other components of the final examination. Moreover, the weak relationship could also be attributed to the subjectivity of the marking criteria used by teachers for the practical examination, hence gave students higher marks. On the other hand, the same students performed poorly in the theory part of the examination as it is written under strict invigilation and objectively marked. The results imply that practical examinations is a good predictor of theory examination, therefore if properly handled and managed, it could enhance the declining students' performance in the standardized final examinations and also improve the quality of education in Botswana at large.

This study's findings concur with Thobega and Masole (2008) who also found low positive and significant relationship between students' performance in theory paper 1 and their performance practical paper 3 and between theory paper 2 and practical paper 3 for BGCSE Agriculture for the years 2001 through 2007. Thobega and Masole (2008) also found that practical examination explained only a small amount of the total variance between the final forecast grades in Agriculture. They argued that the relationship was low because practical examination is school based while the theory papers were cognitive examinations. In other words, students can perform well in practical's examination even if they have low cognitive abilities. All what they are mostly required is to maintain their vegetable plots with little application of cognitive ability. The process of maintaining the gardens involves labor or physical ability such as cultivating, weeding and watering which do not involve mental application. Similarly, the current study findings also concur with those of Isaiah and Isaiah (2017), who also found small variations in the predicted values of student's performance in practical school test scores and their performance in BGCSE final examination in Agriculture.

Collectively, the findings of this study, and those of Thobega and Masole (2008) and Isaiah and Isaiah (2017) highlight important implications for Botswana Examinations Council, the Ministry of Basic Education and for policy makers as far as student learning and assessment of Agriculture at junior secondary level is concerned. This study has evidently shown that although students' performance in the practical examination successfully predicted their performance in the theory examination, the same students' performance in the theory part of the examination was poor. The implication of this finding to the Botswana Examinations council is for the unit to revisit its student assessment policies to ensure that there is an alignment between its assessment criteria used by teachers at school level and that of BEC. This is based on the argument made by Molelekwa (2012) who indicated that as a result of the difficulty in implementing the grading criteria that teachers receive from BEC, many teachers tend to use their own unstandardized grading criteria. As a result this has since 2010, lead to grade inflation of final examination Agriculture practical scores submitted by different schools to BEC (Hulela, 2017), an indication that teachers give students higher marks in the practical examinations due to their subjective grading of this examination.

Masole and Tsheko (2007), argued that school-based assessment is authentic, as teachers can observe and assess the learning process, not just the final product. On a similar view, Yip and Cheung (2005) also assert that school-based assessments provide a more holistic and valid measurement of student abilities. Regardless of these, Masole (2011) points out that the conduct of practical Agriculture examinations in Botswana secondary schools is faced with constraints such as lack of standards, inadequate qualified teachers, inadequate resources, poor administrative support, time constraints and financial constraints as well as poor performance standards. Supporting these sentiments, Mareka (2016) argued that factors such as students' absenteeism from school, discipline problems, students' socio-economic background and lack of resources among others can account for the remaining variance in students' performance in the theory examinations. All these can have major implications on the quality and credibility of the whole examination process.

Regardless of these shortcomings, the Revised National Policy on Education (RNPE, 1994), the Botswana Education and Training Sector Strategic Plan (ETSSP, 2015-2020) and Botswana Vision 2036, all envisage Batswana to be a knowledgeable nation with relevant quality education that emphasize relevant technical and vocational skills needed for its economic diversification plans. In other words, these policies direct Botswana's education to be an education with production. Thus, to meet these long-term national goals as stipulated in national policies, long term vision and strategies the education system need to produce graduates who have desired skills and competencies essential for labor markets. These may require a more profound overhaul of national education system to focus attention on the teaching and assessment of practical based subjects such as agriculture. Teachers should be trained and exposed to issues of quality assessment particular on assessment of practical based subjects such as agriculture with particular reference to their validity, reliability and fair assessment. Therefore they should be trained to have skills needed for production an education which is meaningful to teaching and learning process.

Study limitations
Due to time constraints, the study only used practical and theory JCE final examinations scores in Agriculture. Since the study used students' scores which were in the continuous form, only the

quantitative method was used. Moreover, the study is limited to only Junior Secondary Agriculture performance of students in Government schools.

Conclusion

The major finding of this study is that student performance in practical examination has a predictive validity of their performance in the theory examination in Junior Secondary Agricultural examinations. This means that students' practical work plays an important role in their learning process. Findings of this study can clearly be used as a point of reference for the Ministry of Basic Education to revisit their teaching and learning curriculum for practical subjects such as Agriculture with a view to enhance the teaching and assessment of practical subjects and align them with the national long-term vision, goals and strategies all which emphasize the need to produce graduates who possess skills and competencies beyond what they learned in class, to help Botswana diversify its economy. Findings of this study are relevant in the era where outcome-based learning is highly emphasized. It remains apparent to continue training teachers on outcome-based assessments to ensure that they are equipped with requisite skills to produce students who have attained necessary knowledge skills needed for future career endeavors. These sentiments are supported by Darling-Hammond and Adamson (2010) who pointed out that the role of performance assessment in achieving the 21st century standards of learning has become a constant theme in many educational forums around the globe. This is based on the need to produce learners who possess skills needed to cope with ever increasing demands in complex technologically connected and fast changing world economies. Clearly, this shows the need for educators to make efforts to overhaul their assessment policies and incorporate measures that match current student assessment reforms which emphasize outcome-based learning especially in practical based subjects such as agriculture.

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