Predicting students' performance on agricultural

science examination from forecast grades

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Abstract: The Botswana Examination Council (BEC) uses forecast grades obtained from secondary school Agriculture teachers to review component 2 of Agriculture final examination. Moderation of component 2 can help to improve candidates' final grade. This descriptive-correlational study purports to determine which of the component 1 (multiple choice), component 2 (structured questions), and component 3 (course work) of the BGCSE (Botswana General Certificate of Secondary Education) agriculture can be used to predict students' forecast grades. Examination scores spanning seven years (2001-2007), were obtained from BEC records. Two senior secondary schools were randomly selected from each of the five educational regions in Botswana, and then a systematic random sample of candidates with their respective scores was obtained from each of the selected schools. A multiple regression analysis was conducted using a backward procedure and it revealed that all the components 1, 2 and 3 significantly predicted forecast grades. Components 2 shared the largest (31.6%) variability with forecast scores. It was recommended that teachers should use composite scores from different school-based assessments to determine forecast grades.

Key words: school-based assessment; examination grades; forecast grades; examination components; performance in examination

1. Introduction

Reforms in the national examinations systems can be expected each time an education system effects curriculum changes. Cases in point include South Australia and South Africa. In South Australia, Mercurio (2007) reported that the Department of Education decided to shift from external assessments to different combinations of external and school-based assessments after 1984 when the school curriculum was accredited locally. In South Africa, Long (2006) reported that democratisation brought about changes that included consolidation of the formerly segregated curriculum and the introduction of school based assessment to complement the national final examinations. Sceptical questions usually follow new curriculum and examination reforms. For example, questions about validity, reliability, monitoring of the examination process and moderation of the school based examinations arose in the case of South Africa. McGaw (2006) also underscored the importance of reliability and validity of examinations irrespective of the type, format or even purpose of the examination.

In Botswana, the *Report of the National Commission on Education of 1993* proposed several educational

reforms. One of the major reforms proposed was the localization of senior secondary school examinations. Recommendations tied to the examination localization reform were: the formation of a National Examination Council; training of examiners and markers for all subjects; preparation, re-writing and adaptation of syllabi to local relevance and context; setting of examination papers; and grading system of the scripts with Cambridge as a moderating body (RNPE, 2004). As a result of the recommendations, the Botswana Examination Council (BEC) was established with a general mandate of conducting school examinations and any other examinations for the Ministry of Education and issue certificates in respect of such examinations (Republic of Botswana, 2002).

Localization of the senior secondary schools examinations came with its own benefits; a few of which were development of local expertise, shift to subject-based grading, and development of locally oriented and more relevant syllabi (RNPE, 1994). Consequently, teachers related better with the syllabi since they were based on the local content, culminating in setting more valid and reliable examinations (Utlwang, 2003).

Botswana General Certificate of Secondary Education (BGCSE) replaced COSC which was an international examination administered by University of Cambridge Local Examination Syndicate (UCLES). This change was necessary since COSC was proving to be irrelevant as it was not designed with local issues and cultural set-up in mind (Utlwang, 2006). On the other hand, BGCSE was to be a quality assurance measure since it would examine the local syllabi which were based on the philosophy of Botswana's education system (Utlwang, 2003). Notwithstanding the localization of examinations, the structure of examinations remained the same for most of the subjects. For example, three components for Agriculture: paper 1 (multiple choice), paper 2 (structured questions), and paper 3 (course work) were maintained (Masole & Tsheko, 2007). The grading criteria of examinations, however, changed from COSC's group-subject examination to BGCSE's subject-based examination. Thus, under COSC, a student grade was determined by adding up students' performance from a group of subjects, with performance in English determining the candidates' ultimate final grade (Utlwang, 2006), while under BGCSE subject-based system, subjects grades are independent of each other.

The other aspect of COSC that transited into the BGCSE was the use of forecast grades. The BEC requests secondary school subject teachers to estimate final examination grade for each of the students they teach. Masole and Utlwang (2005) alluded that forecast grades are used as an additional benchmarking mechanism to increase precision of judgement and credibility of examination results. Forecast grades are produced at school level by the classroom teachers. It is to the discretion of the subject teacher to use scores from any school-based assessment to forecast students' final grade. Thus a variety of teacher-made test formats may be used (Masole & Utlwang, 2007). Though Frisbie (1988) noted that teacher-made test reliability is often low, reliability levels of around 0.50 could be tolerated if such scores would be combined with other information for decision-making about individuals.

In the case of agriculture in Botswana, the teacher-made tests that teachers might use include multiple choice tests, structured tests, practical tests, or a combination of these to forecast students' final grades. However, it is evident from Masole and Utlwang's study that forecast grades have a questionable reliability. A similar view about school based assessment was advanced by Kellagan and Greaney (1992, p. 46) that:

> Despite its central role in the teaching-learning process, we do not know a great deal about how teachers assess their students. There is evidence however, that the quality of these practices may be deficient in many ways.

Added to that, the BEC does not have control of which school based tests teachers should use for forecasting. Whether they use students' scores from school based tests similar to component 1, component 2, or component 3 of the final examination is not known.

The disparity in candidates' forecast grades and provincial final examination grade is used to flag candidates who narrowly missed the next higher grade, but BEC only reviews component 2, ignoring other components. This disadvantages a number of candidates who are stronger in the other components. Knowing the relationship between forecast grades and the three components may help the BEC choose the component for reviewing to improve grades for such candidates.

2. Purpose and objectives

The purpose of this study was to predict candidates' forecast grades using component 1, component 2, and component 3 of the BGCSE agriculture. Specific objectives were:

(1) To describe performance of secondary school candidates' in BGCSE Agriculture examinations in Botswana between years 2001 and 2007.

(2) To determine the relationship between the secondary school candidates' forecast grades and their component 1, component 2, and component 3 scores of the BGCSE Agriculture.

(3) To predict candidates' forecast grades using component 1, component 2, and component 3 scores of the BGCSE agriculture.

3. Methodologies

This descriptive-correlational study purported to determine whether students' scores on component 1, component 2, and component 3 of the BGCSE final Agriculture examination could significantly predict the students' forecast grades. The Botswana Examination Council was contacted and requested to supply the authors with Agriculture Final Examination records from the years 2001 to 2007. The following information was then extracted from the documents; students' code, school, forecast grade, final mark and scores for components 1, 2, and 3.

Stratified random sampling was used to randomly sample two schools from each of the five educational regions of Botswana, namely South, South Central, Central, North and Western regions. The sampled schools were those that had submitted forecast grades for the year in question. A systematic random sampling procedure was then used to sample ten students from each of the two sampled schools, this resulted in a country wide sample of 100 students each year over seven consecutive years, thus an overall sample of seven hundred students was obtained. However, the Western region comprised of only two senior secondary schools, as such they were automatically included in the study. It is also worth noting that in some cases, schools do not submit forecast grades, as it is not mandatory. Where such was the case, another school from the same region was chosen. All the data extracted from the documents was entered into an SPSS spreadsheet for analysis. Descriptive statistics was used to summarize the data on students' performance. Spearman rank-correlations were then conducted between forecast grades and the other three variables (components 1, 2, and 3) to establish the extent of association between them. A multiple regression analysis was conducted using a backward procedure to identify the components that could be used to predict forecast grades.

4. Results

Table 1 shows mean performance in raw scores of components 1, 2, and 3 of BGCSE candidates across the years 2001 to 2007. The maximum possible score for each component were as follows: component 1=40;

component 2=100 and component 3=155. Average performance on component 1 ranged from M=22.8, SD=4.98 in 2005 to M=28.6, SD=4.20 in 2002. The average performance for component 2 ranged from M=37.3, SD=11.88 in 2006 to M=50.3, SD=10.74 in 2001. For component 3, average performance ranged from M=117.0, SD=16.46 in 2007 to M=124.2, SD=15.27 in 2002. The average final score ranged from M=133.4, SD=25.91 in 2007 to M=158.0, SD=22.45 in 2002. Candidates' performance in all components seemed to have been higher during first three years after localization of the examinations, that is, in 2001, 2002, and 2003. A multiple comparison post-hoc test (Scheffe) revealed a sporadic pattern of significant mean differences between the first three years (2001, 2002, and 2003) and the last four years (2004, 2005, 2006, and 2007) on components 1 and 2. Component 3 did not have any significant mean differences between the years. Figure 1 also shows downward trend for components 1 and 2, and a somewhat level pattern for component 3.

Table 1   Average performance of Botswana candidates on BGCSE agriculture for years 2001-2007

Year	Component 1 mark		Component 2 mark		Component 3 mark		Final mark	
	M	SD	M	SD	M	SD	M	SD
2001	27.1	4.51	50.3	10.74	118.3	18.38	156.6	22.45
2002	28.6	4.20	46.2	12.17	124.2	15.27	158.0	22.52
2003	25.4	4.48	44.4	11.25	121.8	17.66	147.3	23.42
2004	23.6	5.05	43.3	11.23	123.5	13.28	142.2	24.76
2005	22.8	4.98	48.7	12.94	120.9	13.56	144.8	25.43
2006	23.5	5.58	37.3	11.88	120.2	12.74	134.9	26.33
2007	23.2	4.91	37.7	13.34	117.0	16.46	133.4	25.91
Average	24.8	5.24	44.0	12.70	121.0	15.46	145.3	25.82

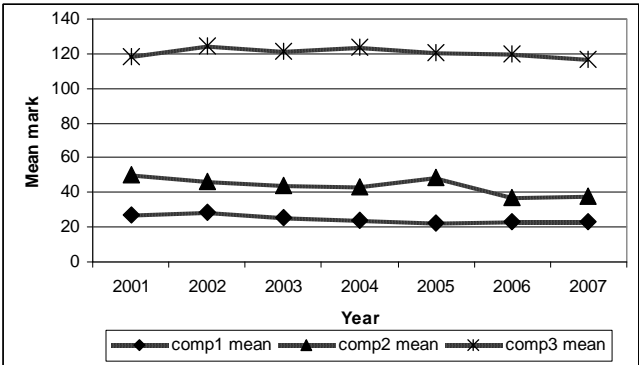Note: Final mark=(Component 1 × 2.5) + (Component 2 × 1.0) + (Component 3 × 0.323).

Figure 1   Mean scores of components 1, 2, and 3 across the seven years

Table 2   Average performance of Botswana candidates on BGCSE agriculture in each educational region

Region	Component 1 mark		Component 2 mark		Component 3 mark		Final mark	
	M	SD	M	SD	M	SD	M	SD
South C	24.6	5.06	43.4	12.83	118.8	15.41	143.2	25.71
South	24.7	5.28	42.8	13.06	119.6	16.32	143.4	25.48
West	25.5	5.31	43.3	13.37	127.8	14.58	148.4	26.89
Central	24.4	5.38	43.3	12.02	117.6	15.13	142.4	25.73
North	25.2	5.18	46.9	12.18	123.9	13.92	149.9	25.12
Total	24.8	5.24	44.0	12.70	121.0	15.46	145.3	25.82

Note: Final mark=(Component 1 × 2.5) + (Component 2 × 1.0) + (Component 3 × 0.323).

Table 2 shows mean performance in raw scores on components 1, 2, and 3 of BGCSE candidates across the five educational regions of Botswana. The average performance on components 1 and 2 were not distinctly

different across regions. There was a very narrow range from M=24.4, SD=5.38 to M=25.5, SD=5.31 for component 1 and from M=42.8, SD=13.06 to M=46.9, SD=12.18 for component 2. For component 3, average performance ranged from M=117.6, SD=15.13 in the Central Region to M=127.8, SD=14.58 in the Western Region. The average final mark ranged from M=142.4, SD=25.73 in Central Region to M=149.9, SD=25.12 in the Northern Region. There was observable pattern of mean differences across regions.
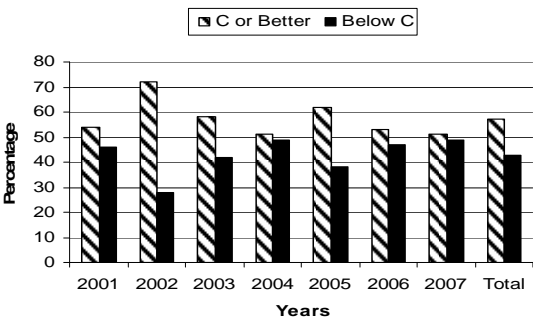

Figure 2   Frequencies of forecast grades between 2001 and 2007 grouped into grades "C or better" and "below C"
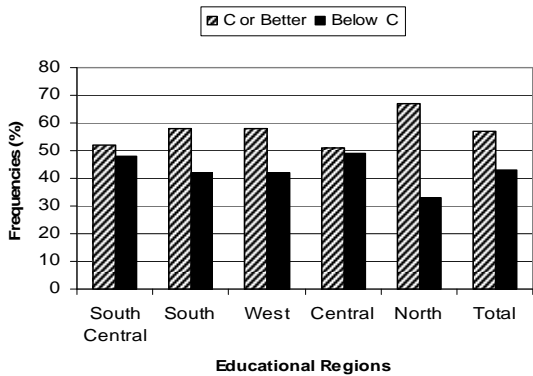

Figure 3   Frequencies of forecast grades in each educational region grouped into grades "C or better" and "below C"

Normally, C or better grades are considered quality grades. Figure 1 shows that through out the seven years in question, Agriculture teachers have been forecasting higher percentages of candidates in the quality grade category than those in the below C grade. Figure 2 shows similar information as in Figure 1 but presented as frequency of candidates whose forecast grades were C or better and those below C across the different educational regions of Botswana. Across educational regions, agriculture teachers forecast higher percentages of high quality grades (C or better) than the below C grade.

Objective 2 was to determine the association between candidates' forecast grades and their component 1, component 2, and component 3 scores of the BGCSE agriculture. The associations were determined by computing intercorrelations between all independent variables (component 1, 2, and 3) and the dependent variable (forecast grades). This was done to justify inclusion of the independent variables in the multiple-regression model. According to Ferguson (1971), to predict one variable from the other, the two variables must be significantly correlated or associated. In the case of the current study all the independent variables (components 1, 2 and 3) were significantly correlated with the dependent variable (forecast grades) (see Table 3), leading to all the independent variables being included in the multiple-regression model. Table 2 also shows that none of the correlation coefficients were very strong (Davis, 1971), so collinearity was not a threat to the regression model.

Table 4 shows that all the independent variables, component 1, component 2, and component 3 made significant contribution to the variability in the forecast grades. That is, each of the three factors could significantly predict forecast grades. However, component 2 contributed the largest percentage of the variability (31.6%) followed by component 1 that contributed 3.1% and component 3 with 1.3% contribution to the variability of the forecast grades.

Table 3   Intercorrelations among independent and dependant variables

	Component 1	Component 2	Component 3	Forecast grade
Component 1	1.00			
Component 2	0.68	1.00		
Component 3	0.32	0.33	1.00	
Forecast grade	0.52[a]	0.58[a]	0.31[a]	1.00

Notes: All correlations are statistically significant. David's (1971) correlation coefficients' scale, 0.70 or higher=very strong association; 0.50 to 0.69=substantial association; 0.30 to 0.49=moderate association; 0.10 to 0.29=low association; [a]Spearman rho correlation coefficients.

Table 4   Multiple regression (forward solution) of forecast scores on components one, two and three of BGCSE agriculture

Independent variables	R^2	R^2 Change	p-value
Component 2	0.316	0.316	< .001
Component 1	0.346	0.031	< .001
Component 3	0.361	0.013	< .001

5. Conclusions and implications

Candidates' performance was high in the initial years of localization probably due to the fact that standards were not yet established. Thereafter, performance seemed to stabilize, though there was some slight downwards trend. This could be an indication that standards had been established. Item-writers, moderators, examiners, and examination graders probably understand their roles well. Across the educational regions, performance is almost the same. This could be attributed to the fact that the government upholds a policy of equitable distribution of resources to all areas of the country, which implies that, all schools in Botswana irrespective of geographical location, are resourced the same. This applies to both physical and human resources; hence, a somewhat uniform performance was expected. The slight differences in performances could possibly be attributed to the socio-cultural differences which define each ethnic group's attitudes towards schooling. While some ethnic groups are favorably disposed to embrace schooling, others are still being persuaded to do so.

Teachers always forecast more candidates to do well probably because of the fact that since they are accountable for their students performance, they would always want to present a positive picture to their supervisors about their students' performance. This saves them from having to explain why their students were failing. Furthermore classroom teachers are almost always optimistic about their students' performance. The bond they established with students compels them, to some extent, to have a positive view of their students' performance.

The BEC knows the kind of tests used to generate final grades for students but do not know the kind of tests used to forecast the final grade. Probably the differences in content, questions of different cognitive domains, and type of questions asked could be the reason why teacher always forecast high. However, it has been established that teachers' classroom assessment are poor (Worther, Borg & White, 1993), characterized by ill-focused questions, predominated by questions that require short answers involving factual knowledge, evocation of

responses that involve repetition rather reflection, lacking of procedures designed to develop students' higher-order cognitive skills (Black & William, 1998; Madaus & Kellagan, 1992).

The substantial positive correlation between component 1 and 2 could be due to the fact that both are written within a restricted timeframe and require the candidate to engage some high order thinking. However, there is low positive but significant correlation, between component 1 and 3 of 0.32 and between components 2 and 3 of 0.33. The correlation may be low probably because component 3 is school-based and it is practical in nature. It involves the candidate carrying out some physical activities and/or identifying a problem and coming up with a solution, while components 1 and 2 are cognitive tests.

The regression model revealed that all components of the BGCSE agriculture can predict forecast grade, or they share significant amounts of variability with forecast grade. However, component 2 shares the largest amount (31.6%) of its variability with forecast grade. Components 1 and 3 share relatively small amounts of variability (3.1% and 1.3% respectively) with forecast grades. This could mean that agriculture teachers use school-based tests similar in nature to component 2 when forecasting students' final grades. Thus students who do well in component 2 are likely to have a quality forecast grade, hence benefit from being flagged and have their final grades improved. Those who score high in any of the other two components may not benefit from the grade forecasting exercise.

The BGCSE agriculture grade is a composite grade computed from candidates' score of components 1, 2 and 3. Agriculture teachers are urged to base their forecast grades on similar types of assessments so that forecast grades could truly be a reflection of the examination. BEC should devise a way of reviewing other components, particularly component 3 when moderating candidates final grade.

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