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COMPARATIVE PARTIAL COMPETENCY BASED TRAINING: A CASE STUDY OF ITS APPLICATION TO THE STATISTICS PROGRAM

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Abstract

In Ghana, the traditional University system is designed to give the learner a sound basis to be able to chart a career path after the initial training. The Polytechnics, on the other hand, have been set up to give its students practical oriented training which provides manpower, largely, for the middle level. In recent times a competency based training regime has been on the lips of every educationist as it is seen as a panacea to churning out graduates who are already prepared for the job market. In Accra polytechnic, competency based training has so far been run in two departments – Mechanical Engineering and Fashion Design. It is clear that there have been some challenges with the adoption of this training approach. However, such a laudable approach to learning must not be dumped but the challenges overcome so as to replicate in the other programs of study in the institution. This paper suggests that a fully competency based training for an entire program may be fraught with several challenges. A better option will be to apply competency based training to aspects of a curriculum. A case study of the Design and Analysis of Experiments content of the Statistics Curriculum has been practically analyzed and the results show that students were more competent in the learning outcomes using this approach than the traditional method of teaching and learning. The experiment was designed as a three factor study and analyzed using ANOVA techniques.

Keywords: Competence, Learning outcomes, Polytechnic, ANOVA.

1.0 Introduction

1.1 The Competency-Based Training Program

Competency-based training is arguably a preferred approach in the impartation of skills to trainees, especially under a Technical and Vocational Education where hands on to the solution of a practical problem is the emphasis. A competency is a set of knowledge, skills, behaviors, attitudes and characteristics that distinguish one person from another. (Richards, 1985). A distinction can be made between different types of competencies. For instance, a Functional Competency relates to technical knowledge or skills required by a particular field or profession. A personal competency is an individual attitude and skill that is required to handle professional relationships and facilitate learning and personal development. A Business competency on the other hand will relate to the ability to view issues or situations from a business perspective. (Burke, 1989). For superior performance on any job, it is possible to identify competency required. Once identified, these competencies can be used for selection or development of employees. It is therefore imperative on trainers of the various training institutions to identify these competencies and impart them on their trainees. A competency-based training system therefore identifies the level of competence required for different level of performance within a given work function. (Harris et al, 1995). It must be noted that a competency-based training must not be necessarily limited to the acquisition of technical skills for typical Engineering and Vocational Programs.

1.2 The Competency-Based Training Program in Accra Polytechnic

As part of the vision of COTVET to institutionalize a quality CBT system in Ghana, all the ten polytechnics in Ghana embarked upon this approach at the HND level in selected disciplines. In Accra Polytechnic two departments, namely Mechanical Engineering and Fashion Design were selected to pilot this new mode of teaching and learning.

Mechanical Engineering in Accra Polytechnic has four options – Plant, Automotive, Refrigeration and Production. The Plant Engineering option was chosen and the entire syllabi re-written in the CBT mode. Students were therefore enrolled on to this program and new mode in the 2009/2010 academic year.

Interestingly, there were two groups of students enrolled under the different modes of training – CBT and the traditional. CBT students spent a little time doing classroom work, with emphasis on skills needed to perform specific tasks. The first batch of students finally graduated in September 2012.

The other department, Fashion Design and Textiles, also went the CBT way and their entire syllabi were also changed to suit this approach. Their first batch of students was enrolled in the 2010/2011 academic year. In their case, only one batch of students was enrolled and they all had the CBT training.

1.3 Challenges Faced in the Competency-Based Training Program in Accra Polytechnic

As is common with the implementation of new ideas in an educational institution, the introduction of this CBT approach also had its fair share of challenges. Notable ones include:

1. The ability to transfer skills and knowledge to new situations,
2. The organization and planning of activities while coping with non-routine situations,
3. The ability to interact effectively with industry,
4. The ability to identify competencies which fits into industry practice,
5. The acquisition of equipments needed for on-campus training,
6. The lack of industry training for lecturers to be abreast with current trends.

1.4 Extension of Competency-Based Training Program to Other Disciplines

Since this approach was piloted in only two programs out of fifteen currently run at the HND level, efforts have been made to convert other disciplines into this mode. However, there is a lack of commitment on the part of lecturers in various departments as well as their heads to undertake this noble idea. The competency standards can be established through analysis of work carried out in industry and that there must be agreement about these standards. It has been an exceptionally difficult process to establish national competency standards in many industries. Further other studies have shown that lecturers have perceived lack of agreement in standards. The fact that the lecturers in the study all had industry experience leads to the conclusion that there is a major problem with the concept of agreed industry-based competency standards. (Keating, 2008). This therefore calls for a good preparation towards a sound competency based training policy in Ghana.

Initially, NABPTEX's ambition was to transform all HND programs into competency-based curricula but funding and technical constraints have necessitated a piecemeal approach. Besides, it is acknowledged that the transformation from the traditional curricula to CBT curricula involves a great deal of organizational learning and cultural change, and these changes do not occur automatically with the launching of CBT documents.

This paper makes a bold attempt to make a case for a partial CBT instead of CBT in its entirety for a program. It is our view that, to whip up interest in lecturers to adopt this mode, there must be a gradual approach, which must begin with some aspects of the curriculum. If successful, this can now be extended to an entire program. We perceive that CBT in at least a single course at each level ion every HND program is a sure way to embracing this novelty.

2.0 Methodology

The study focuses on the Design and Analysis of Experiments content of the HND syllabus. The method adopted is in line with a document prepared by a NABPTEX study group, which identified a standard five-step process for a competency-based training approach:

1. Needs analysis to confirm demand for the training program,
2. Establishment of competency standards,
3. Curriculum development based on standards established by industry,
4. Assessment and Quality Assurance Management,
5. Certification by the awarding body.

Competency-based training curricula and documents also come in a wide range of formats and terminologies, but the focus is on establishing and describing workplace competencies. It begins with a typical/generic job description followed by the identification of units of competency (sub-divided into generic competencies and functional area competencies). Thereafter, the focus is on detailed analysis and description of units of

competency. The NABPTEX study group further provided a format for presenting units of competency as follows:

1. Specification of the title of unit of competency,
2. Assignment of a code to the unit of competency for easy reference,
3. Specification of the qualification level to which the unit belongs,
4. Brief description of the unit of competency – what the unit is about,
5. Breakdown of the unit of competency into its constituent elements,
6. Specification of performance criteria for each element of the unit,
7. Identification of essential knowledge, skills and other attributes to be acquired and assessed (from an industry perspective),
8. Specification of Range of Variables or application contexts (contexts, conditions and resources)

In describing performance criteria, the active form is also adopted. After re-writing the Design and Analysis of Experiments course into the CBT mode, an attempt was made to practicalize it. The experiment was designed as a three factor study and analyzed using ANOVA techniques.

3.0 Findings

The content was first converted to a CBT mode following the format described above.
Unit of Competency: Analyze a Three Factor Study in an Experimental Design
Unit Code: B18
Qualification Level: HND
Unit Description: This unit covers the knowledge, skills and attitudes required to understand and apply a three factor study to industrial problems.

Competency Element	Performance Criteria
B18.1 Set up a study in a factorial design setting	1.1 Recognize a data presented in a table in three dimensions. 1.2 Clearly identify the experimental factors and their levels in the study. 1.3 Identify both main and interaction effects. 1.4 Distinguish between first and second order interactions.
B18.2 Transform a three dimensional data into separate two dimensional tables	2.1 Reconstruct three two-dimensional tables from the original data. 2.2 Perform summations for the cross tabulations.
B18.3 Calculate Sum of Squares	3.1 Find the total sum of squares 3.2 Compute the sum of squares for main effects 3.3 Compute two-factor interaction sum of squares
B18.4 Perform Hypothesis Testing	4.1 Test for main effects 4.2 Test for interaction effects 4.3 Draw appropriate conclusions

3.1 Essential knowledge and skills to be Acquired and Assessed

1. Recognizing a data presented in a table in three dimensions,
2. Identifying the experimental factors in the study,
3. Identifying main and interaction effects,
4. Distinguishing between first and second order interactions,
5. Reconstructing three two-dimensional tables from the original data,
6. Performing summations and computing sum of squares,
7. Testing hypothesis and drawing conclusions.

3.2 Range of Variables (work context, conditions and resources)

1. Working in teams and leading discussions,
2. Recognizing and identifying experimental factors, main and interaction effects,
3. Collapse a three dimensional table into two dimensional tables,
4. Computer software and applications,
5. Models,
6. Laboratory fully equipped,
7. Printers,
8. Internet connectivity,
9. Simulation programs.

After re-writing the Design and Analysis of Experiments course into the CBT mode, an attempt was made to practicalize it. A hypothetical situation was narrated and students were made to analyze the data using this approach. The experiment was designed as a three factor study and analyzed using ANOVA techniques. A narration was given as follows:

Suppose the Ghana Football Association tests two different brands of footballs to be used in a football league season. Each of the football is randomly assigned to three top strikers from three of the leading football clubs in the country. Each striker is supposed to shoot the ball to score from any distance towards the goal post. Data was obtained on the distances (in metres) traveled by the ball as shot by the various strikers and the summary results in Table 1 as well as the ANOVA table in Table 2, were obtained, using the learning outcomes above.

The appropriate tests are:

Test for Main Effects

The hypothesis of interest is that none of the three factors has an effect on the distance travelled by the ball at $\alpha = 0.01$

Since $F_A > F_{0.01}$, H_0 is rejected. We conclude that the football club has a significant effect on the distance travelled by the ball.

Since F_B and $F_C < F_{0.01}$, H_0 is not rejected. We conclude that brand of football and striker independently has no effect on the distance travelled by the ball.

Test for Interaction Effects

The hypothesis of interest is that none of the interaction factors has an effect on the distance travelled by the ball at $\alpha = 0.01$

Since $F_{AB} > F_{0.01}$, and $F_{ABC} > F_{0.01,}$ H_0 is rejected in each case. Interaction of football club and brand of football, and also interaction of all three factors have a significant effect on the distance travelled by the ball.

However, F_{AC} and $F_{BC} < F_{0.01,}$ H_0 is not rejected. We conclude that interaction of football club and striker and also interaction of brand of football and striker have no effect on the distance travelled by the ball.

4.0 Discussions and Conclusions

A competency based training policy is an industry and demand-driven, outcomes-based education and training program based on industry generated standards. Such industry standards form the basis upon which program/curriculum assessment and learning materials are designed and developed. The outcomes based

approach highlights the viewpoint that what and whether learners learn effectively is more important than when and how they learn something. In this study, we have established clear measurable standards. With this approach, we develop competent individuals with transferable skills and link education and training to skills needed by employers. The emphasis is on breaking a competence element into bits of performance criteria which are clearly measurable and the competency demonstrated by the learners. This will eventually establish an objective quality assured system which will have the confidence of all users, ie. learners, educational establishments and employers. By promoting the concept of lifelong learning we also develop the potential of individuals to optimal levels.

In this study, the students were assessed on the essential knowledge and skills acquired. The data in the narrative was three dimensional and the following learning outcomes were achieved.

1. Recognizing a data presented in a table in three dimensions,
2. Identifying the experimental factors in the study,
3. Identifying the main and interaction effects,
4. Distinguishing between the first and second order interactions,
5. Reconstructing three two-dimensional tables from the original data,
6. Performing summations and computing sum of squares,
7. Testing hypothesis and drawing conclusions.

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APPENDIX

Table 1: Summary Results

SST	668.89	SSC	5.06	$SSBC_{sub}$	59.22	SSAC	61.11
SSA	221.72	$SSAB_{sub}$	297.56	$SSABC_{sub}$	616.89	SSBC	47.05
SSB	7.11	$SSAC_{sub}$	287.89	SSAB	68.73	SSABC	206.11

Factor A = football club Factor B = brand of football Factor C = striker

Factor Levels are: a = 3 b = 2 c = 3 n = 2 N = abcn = 36

Table 2: ANOVA TABLE

Source	SS	Df	MS	F
A	221.72	2	110.86	38.36
B	7.11	1	7.11	2.46
C	5.06	2	2.53	0.88
AB	68.73	2	34.37	11.89
AC	61.11	4	1.53	0.53
BC	47.05	2	23.53	8.14
ABC	206.11	4	51.53	17.83
Error	52.00	18	2.89	
Total	668.89	35		