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Bachelor of Technology (B-Tech) Programme in Building Technology at the Sunyani Polytechnic Based On the Competency-Based Training (CBT) Model: A Review

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Abstract

The Bachelor Technology (B-Tech) in Building Technology programme was introduced at the Sunyani Polytechnic as part of measures towards providing an academic progression route for HND Building Technology graduates and to train professionally competent manpower to help improve the construction industry in Ghana. The competency-based training (CBT) model was adopted as the mode of training. This paper seeks to review the B-Tech (Building Technology) programme, in line with the CBT model, since its inception at the Sunyani polytechnic. The study involved interviewing stakeholders like staff of polytechnic, employers and graduates of the programme. Relevant materials like annual evaluation reports and accreditation documents were also consulted. It was discovered that an adapted version of CBT was employed in the implementation of the programme with the internship phase of the training being the highpoint in the CBT practice. Logistical constraints and low familiarity with the CBT concept were identified as some constraints to the implementation of the program in line with CBT.

Keywords: Competency-Based Training, Bachelor of Technology, Building Technology, Sunyani Polytechnic

1. Introduction

One of the problems that have confronted the educational sector in Ghana has been the academic progression opportunities available to graduates of Higher National Diploma (HND) turned out from the country's polytechnics. HND graduates who wished to continue their education in Ghana were not only denied direct entry to pursue graduate programmes like MSc. in Ghana's public universities, but had to start from first year and spend four years to obtain degree certificates such as Bachelor of Science or Arts certificates. The apparent uncertainty regarding academic and career progression of HND graduates led to some frustration and agitation among these graduates and polytechnic students in the country, occasionally leading to rioting (Nyarko, 2011).

The Bachelor of Technology (B-Tech) programme was therefore proposed for introduction at the polytechnics in Ghana to provide an opportunity for HND graduates to pursue higher academic programmes to the bachelor's degree level (Nyarko, 2011). Apart from providing academic progression opportunities for HND (Building Technology) graduates, the B-Tech in Building Technology programme was introduced at the Sunyani Polytechnic in 2007, in conjunction with the Cape Coast Polytechnic, to contribute to an improvement in the construction industry in Ghana by training practically-oriented management level manpower to feed the construction industry. The implementation of the programme at the two polytechnics was supported by the NPT/Gha/047 project of the Netherlands government and her Ghanaian counterpart, through a collaborative venture with the Kwame Nkrumah University of Science and Technology (KNUST) of Ghana, and the Technical University of Eindhoven (TU/e) of the Netherlands. The Competency-Based Training (CBT) model was adopted for the B-Tech in Building Technology programme to ensure that products of the programme obtained the required practical and professional competence expected of them in the construction industry.

It has been four years since the introduction of the Bachelor of Technology programme in Building Technology at the Sunyani Polytechnic. The first three batches of graduates have completed while the fourth batch is about to complete. This paper seeks to review the B-Tech (Building Technology) programme since its inception at the Sunyani Polytechnic to identify the successes and challenges that have been associated with the implementation of the programme using the CBT model.

2. Polytechnic Education in Ghana

The origin of polytechnic education in Ghana can be traced back to the establishment of Technical Institutes in Ghana to run craft programmes. The establishment of these Technical Institutions in Ghana was necessitated by the formulation of the industrial development policy in 1960, as well as rapid technological progress in a wide range of areas (Nsiah-Gyabaah, 2005).

The Technical Institutes, in 1963, were re-designated as polytechnics to run non-tertiary programmes like the Construction Technician Course (CTC). In line with this re-designation, technical institutes like that of Tamale and Ho were upgraded to polytechnic status in 1984 and 1986 respectively (Boakye-Agyeman, 2006). The promulgation of the Polytechnic Law in 1992 (PNDCL 321) transformed the polytechnics into tertiary institutions therefore giving polytechnics the mandate to run tertiary programmes. The polytechnics began running Higher National Diploma (HND) programmes in 1994. The Sunyani Polytechnic, in line with government's policy of creating a polytechnic in each of the ten regions of Ghana, was created in 1997 from the then Sunyani Technical Institute. The role of polytechnics in Ghana was distinctly spelt out by government to develop middle-level manpower. Courses at the polytechnic were to be offered at the middle-level of technical training leading to the award of HND with the syllabi dedicated to practical training. The mounting of such programmes was expected to complete the cycle of technical education and provide an opportunity for higher level technician training and practical research (Ministry of Education, 1993).

2.1 Objectives of Polytechnics in Ghana

The polytechnic Law of 1992 (PNDCL 321) set out the following objectives towards which polytechnics in Ghana strived to achieve:

- Provide tertiary education through full time courses in the field of manufacturing, commerce, science, technology, applied social science, applied arts and such other areas as may be determined by the authority for the time being responsible for higher education.
- Encourage study in technical subjects at tertiary level, and
- Provide opportunity for development, research and publication of research findings.

The polytechnic law, towards ensuring that the polytechnics effectively discharge their mandate to achieve the above objectives, gave legal backing to desirable changes in polytechnic administration, course structure, grading, certification and staffing. The Polytechnics in Ghana now have their own governing boards or councils and the right to design their own curricula, plan their management and development activities (Boakye-Agyeman, 2006).

2.2 The Polytechnics Act of 2007 (Act 745)

The passage of the polytechnic Act (Act 745) in 2007 sought to revise the law relating to polytechnics in Ghana. Even though the objectives of the polytechnics, under Act 745, did not see any dramatic change from the stipulations of the previous law, the Act sought to give more academic autonomy to the polytechnics. One other significant provision under the polytechnics act of 2007 was the empowerment of the polytechnics to award degrees. This provided a legal framework for the Sunyani polytechnic to commence the B-Tech programme in building technology and award its own certificates.

3. The Concept of Competency-Based Training (CBT)

One of the major concerns of stakeholders in the Ghanaian tertiary education, particularly polytechnic education, is adapting training to the needs of industry or the labour market. This, in the view of these stakeholders, will not only make graduates of tertiary educational institutions readily employable, but also contribute immensely to increased productivity and national development. A shift from the traditional time-based credit hour system, to a focus on competencies required by industry in the training of students is therefore expected. In Ghana today, one of the key issues of polytechnic and vocational education is the introduction of competency-based training (Nyarko, 2011).

3.1 What is Competency-Based Training (CBT)?

Competency refers to a combination of skills, abilities, and knowledge needed to perform a specific task. Competency-based training (CBT) can thus be defined as purposeful training actions undertaken by

postsecondary institutions directed at defining, teaching, and assessing competencies across their system (Jones et el., 2002). Unlike in the traditional educational system whereby unit of progression is time and teacher-centered, in a CBT system unit of progression is mastery of specific knowledge and skills and is learner or participant centered (Sullivan, 1995). CBT involves "self-directed inquiry" or "do-it-yourself" approach (Afetiet el., 2003). Students under the CBT model are expected to develop their individual talents, interests, and skills leading to occupation in various sectors of the economy (UNESCO/ILO, 2002).

In the view of VEETAC (1992), CBT is training geared to the attainment and demonstration of skills to meet industry-specified standards rather than to an individual's achievement relative to that of others in a group. The key concerns of CBT are generally seen to be that:

- focus of training should be on the outcome of the training
- outcome is measured against specified standards, not against other students
- standards should relate to industry requirements (Smith and Keating, 1997).

3.2 Characteristics of CBT

Competency-based training programmes are identified with the following characteristics as shown in Table 1 below (Foyster, 1990; Delka, 1990 and Norton, 1987):

Table 1: Characteristics of CBT (Foyster, 1990; Delka, 1990 and Norton, 1987)

1.	Competencies are carefully selected
2.	Supporting theory is integrated with skill practice. Essential knowledge is learned to support the performance of skills
3.	Detailed training materials are keyed to the competencies to be achieved and are designed to support the acquisition of knowledge and skills.
4.	Methods of instruction involve mastery learning. The premise that all participants can master the required knowledge or skill, provided sufficient time and appropriate training methods are used
5.	Participants' knowledge and skills are assessed as they enter the program and those with satisfactory knowledge and skills may bypass training or competencies already attained.
6.	Learning should be self-paced.
7.	Flexible training approaches including large group methods, small group activities and individual study are essential components.
8.	A variety of support materials including print, audiovisual and simulations (models) keyed to the skills being mastered is used.
9.	Satisfactory completion of training is based on achievement of all specified competencies.

3.3 Advantages of CBT

Competency-based instruction has a tremendous potential for the training industry (Watson, 1990). Focus on the success of the trainee is one of the primary advantages of CBT (Sullivan, 1995). According to Watson (1990) the CBT approach appears to be particularly useful in training situations where learners have to attain a small number of specific and job-centered competencies. The specific benefits of CBT as identified by Norton (1987) include:

- Participants achieve competencies required in the performance of their jobs

- Participants build confidence as they succeed in mastering specific competencies
- Participants receive transcript of list of competencies they have acquired
- Training time is more efficiently and effectively managed as the trainer is the facilitator of and not a provider of information
- More training time is devoted to working with participants individually or in small groups as opposed to presenting lectures
- More training time is devoted to evaluating each participants ability to perform essential job skills

3.4 Limitations of CBT

Despite the fact that a number of advantages have been recognized as being associated with CBT, Sullivan (1995) has identified the following limitations in the CBT approach:

- If initial training and follow-up assistance is not provided for the trainers, there is a tendency to "teach as we were taught" and CBT trainers may slip back into the role of the traditional teacher.
- A CBT course is only as effective as the process used to identify the competencies required. When little or no attention is given to identification of the specific job skills, then the resulting training course is likely to be ineffective.
- A course may be classified as competency-based, but unless specific CBT materials and training approaches (e.g., learning guides, checklists and coaching) are designed to be used as part of a CBT approach, it is unlikely that the resulting course will be truly competency-based.

3.5 Implementation of CBT

The concept of competency-based training is undergoing continuous change and this is accompanied by a development of different ideas and various approaches in its implementation (Tippelt et al., 2003). The development of the various approaches of CBT apart from being a response to the changing demands of time is also meant to meet diverse national aspirations, programs or capabilities. Experiences in some countries indicate that in the strict and rigorous application of CBT, one could achieve similar results in CBT by applying other types of teaching methods for a curriculum that is based on the terms of reference that comply with needs and competency requirements of the labour force (Van Egmond and Erkelens, 2006). In the Netherlands there have been quite some adaptations and revisions regarding the original CBT method (Wouw and Hoorn, 2006).

Van Egmond and Erkelens (2005) found out in a survey carried out at the Sunyani and Cape Coast Poytechnics that students were not as self-supporting as expected and is required for a strict CBT learning method. It was also discovered that teachers could also become de-motivated because they could no longer share their knowledge and experience with the students since under a strict CBT methodology, teachers would just act as coaches in guiding an independent learning process.

Based on the findings above, CBT methodology should be considered in an adapted and appropriate form for application at the polytechnics in Ghana so that it can be applied as an instrument for achieving linkages between the educational institutions and the industry, businesses as well as community enterprises. The required competences of graduates in professional jobs in the construction industry should definitely be the centre point in the development of the curriculum for the adapted approach (Van Egmond and Erkelens, 2006).

4. Materials And Methods

The paper seeks to review the implementation of the Bachelor of Technology (B-Tech) programme in Building Technology at the Sunyani Polytechnic in line with the CBT model. Relevant documents like the curriculum, initial proposals, accreditation documents and annual evaluation reports formed one of the main bases for data, especially on training procedure. Besides, Lecturers, administrative staff, technicians and students of the Building Technology Department of the Sunyani Polytechnic who have been involved in the implementation of the programme were interviewed to obtain data. Sections of industry who have been involved in the training of students through internship programmes, as well as those who have employed graduates were contacted to obtain

information on the performance of B-Tech (Building technology) graduates as well as their general impressions about the programme.

Relevant data on the various stages of implementation of the programme was obtained and analysed in linewith the tenets of CBT. This was expected to give an opportunity to establish the level of compliance of the programme with the requirements of the CBT model.

5. Findings

5.1 Development of the Curriculum

The study revealed that the curriculum for the B-Tech (Building Technology) was developed by exploring an adapted version of the CBT approach. The required competencies of graduates in professional jobs in the construction industry were taken into account in the application of the adapted approach. The curriculum had to therefore include components which enable the student to practice the acquired basic knowledge and skills in practical project situations similar to professional job situations.

Table 2 shows a summary of the procedure that was adopted in formulating the curriculum for the programme:

Table 2: Curriculum Development Procedure

i.	Definition of aim and objectives of curriculum
ii.	Identification of possible areas of employment for graduates
iii.	Identification of specific competencies that must be developed in the graduates
iv.	Grouping professional job tasks that were more related and identifying overlapping tasks
v.	Linking summarized job tasks to relevant employability skills, based on a comprehensive list of engineering employability skills of graduate engineers
vi.	Identification of appropriate teaching methods to develop required competencies
vii.	Development of general overview of the structure of curriculum by defining the focus of the curriculum at each level of training and specific competencies that have to be developed
viii.	Identification of specific courses in relation to competencies resulting in grouping courses into semesters' work
ix	Development of detailed course content together with teaching and assessment methods

A series of consultative meetings, workshops and seminars were held during the development of the curriculum to incorporate inputs from various stakeholders. The major stakeholders in these consultative sessions included the NPT/Gha/047 project implementation partners from TU/e, Eindhoven; staff of the Building Technology Departments of the Sunyani and Cape Coast Polytechnics; Management of the two Polytechnics; staff of the Building Technology Department of KNUST, Kumasi; construction industry practitioners like contractors and consultants; professional bodies like Ghana Institution of Surveyors and Ghana Institution of Engineers; the National Accreditation Board (NAB), the National Council on Tertiary Education (NCTE) and the National Board for Professional and Technical Examinations (NABPTEX). Some consultations were also held with staff of the Hague Polytechnic in the Netherlands to learn from their experiences in the implementation of CBT. The curriculum that was finally adopted for implementation was therefore a culmination of contributions from the trainers, employers, support organizations and regulatory bodies.

5.2 Structure of the Programme

In line with the main objective of the programme of providing opportunity for HND graduates in Building Technology and allied courses to progress academically and also contribute to an improvement in the construction industry in Ghana, The target group for the programme was HND graduates in Building Technology and allied courses, like Civil Engineering and Estate Management, with not less than two years

relevant post-qualification experience. The curriculum of the B-Tech (Building Technology) programme proposed an 18-month duration for the entire programme, comprising three semesters.

5.2.1 First Semester

The first semester was spent on campus to undertake courses to give some level of theoretical and practical exposure, in the area of building technology, to students. Some of the courses which were undertaken at this stage included Building Drawing, Civil Engineering Design, Statistical Methods, Civil Engineering Measurement, Project Planning and Control, Computer Applications, as well as Laboratory and Workshop Practice. Despite the fact that these courses are similar to some courses undertaken in the traditional mode of training, the teaching methodology and assessment method were fashioned in line with CBT requirements. Unlike the traditional mode of training, lecturers were required to employ methods such as problem based learning, peer teaching, group discussions and assignments in teaching. Even though end of semester examination is a major component in the mode of assessment of some courses in the first semester, quizzes, presentations, demonstrations and coursework are also employed in the assessment of courses.

One of the courses in the first semester that largely addressed the concerns of CBT was the integrated project. This course sought to give students the opportunity to simulate professional practice in the construction industry. Students, in this course, were given a live project and were expected to play the roles of consultants, contractors and clients to undertake pre-construction documentation of the project. Students were expected to undertake a practical application of most of the courses they learnt in the first semester in the integrated project. Critical professional competencies like preparation of bill of quantities, tender documentation, contract documentation as well as technical and financial proposal writing were expected to be acquired in this course. Problem based learning, peer teaching, group discussions and seminars were the main teaching methods whereas presentation was the key method of assessment.

5.2.2 Second Semester

Beyond the simulations on campus, it was believed that exposing students to real life job environments was best for building professional competencies. The second semester was therefore devoted to a six-month internship programme to enable students learn directly from potential employers within a real professional/job environment. Students, during the internship period, were posted to various private and public organizations operating as construction firms, consultancy firms, estate developers or project implementation agencies.

Each student was assigned to a supervisor or mentor within the organization to directly supervise and assess their performance and level of competence. The supervisor used an assessment form provided by the polytechnic to undertake a weekly assessment of the student with respect to the competencies that he/she had acquired. The student was also given a log book to keep a detailed daily record of his/her activities and job tasks performed. A minimum of two visits were undertaken by at least two lecturers to monitor and assess the performance of the students during the internship. The major teaching method employed during the internship period was problem based learning, assignment, peer teaching and group discussion. The key assessment methods in the second semester were presentations, interviews and demonstration. Students had, in a number of instances, been retained by organizations for employment after exhibiting a satisfactory level of competence during the internship.

5.2.3 Third / Last Semester

Students returned from their internship to complete the last semester. The structure of the courses in the last semester was similar to that of the first semester. Students undertook courses like civil engineering design, professional practice and management, project cost management and project resource management. Like in the first semester, the method of teaching these courses included group discussions, problem based learning and peer teaching. Assessment of students was also done through assignments, presentations, course work, examination etc. Students, in the course of this semester, also shared their experiences, during the internship, with their colleagues and lecturers.

The project work is one of the key courses during the third semester. This course required that students identified a particular problem in the construction industry to undertake an investigation to come out with possible solutions presented in a report. Students were normally encouraged to identify these problems particularly during

the period of their internship. The key assessment method for this course was presentation. Undertaking the project work was also expected to sharpen the research skills of the students for application not only in their professional career, but also in their pursuit of higher degree programmes like Master of Technology (M-Tech) afterwards.

5.3 Performance of the Graduates

For all the three batches of students who enrolled for the programme, most of the students took study leave from their employers to pursue the programme. Even though some students changed their job upon completing the programme, majority of them went back to their original employers. Graduates who went back to their former employers gave an indication that they went back, after the programme, more confident than before to perform more challenging tasks at their respective organizations. The feedback from their employers also corroborated this assertion by the graduates. According to the employers, apart from the graduates becoming more competent in the performance of their core job tasks, they responded to tasks with a better level of independence and team spirit. The improved performance and upgraded qualification of the graduates led to employers promoting them to higher positions in their organizations.

Most of those who had new employment after the programme were graduates who were retained by organizations where they did their internship. It was out of the sheer demonstration of professional competence by these graduates during the internship that led to their employment in these organizations. There was less attention by these employers to the paper qualification/certificates of these graduates before they were considered for employment. Most of these employers operate in various sectors of the construction industry like consultancy services, construction and real estate development.

Even though the B-Tech (Building Technology) programme was focused on developing the professional competence of students for jobs in the construction industry, the curriculum was also fashioned to make it possible for graduates of the programme to pursue higher academic programmes. A number of the graduates, especially those of the first batch, have enrolled to pursue higher degree programmes like Master of Technology (M-Tech) in construction technology and Master of Science (MSc) in project management at various universities in Ghana. The graduates on these programmes have indicated that going through the B-Tech (Building Technology) gave them a good foundation to go through their graduate programme courses successfully. The feedback from the instructors of these higher programmes also point to a satisfactory performance by the B-Tech graduates.

5.4 Quality Assurance and Control Measures

Some quality control measures were put in place to ensure a successful implementation of the programme and compliance with the requirements of the curriculum. This involved the appointment of an external moderator to periodically review the various activities on the programme and making recommendations. The moderator went through documents like assignments and coursework submitted by students, internship reports, examination questions and marked scripts to inform his comments and recommendations. Feedback from students on the performance of lecturers and the effectiveness of the entire programme in meeting their aspirations was also obtained to help in continuous improvement. The quality control activities were coordinated by the staff of the Department and the Quality Assurance and Control Unit of the polytechnic.

5.5 Challenges

Notwithstanding the modest strides that have been made in the implementation of the B-Tech (Building Technology) programme, it has not been without challenges. One of the key challenges in trying to run the programme on the CBT model has been the low level of familiarity of the concept of CBT to trainers, trainees and the employers in Ghana. Despite the fact that some level of orientation and training in CBT had been given to staff of the Building Technology Department of the Sunyani Polytechnic, a lot more needed to be done in the area of CBT training for staff, especially if there has to be a transition from the adapted CBT model, as is being practiced now, to the strict CBT model.

Students, especially those of the first batch, who have pursued the programme started without any familiarity with the CBT model and enrolled with the mindset of a programme that will run like the traditional training model they experienced at the HND level. The tendency was therefore for these students to be focused on

obtaining good grades and certificates after attending lectures and writing end of semester examinations rather than focusing on acquiring professional competencies. Orientation sessions as well as participation in the training programme however eventually got them to understand the CBT concept to some extent. Most of them particularly saw the internship session as a rare and best opportunity to acquire professional competence directly from industry.

Most employers were not also familiar with the CBT model, especially the strict CBT certification system of either being "competent" or "not competent". They were only familiar with certificates from tertiary institutions that indicated the level of qualification (i.e. HND or BSc or MSc) with the various divisions (either first class division, second class division etc). Besides institutions which offered higher degree programmes like the M-Tech and MSc, that graduates of the programme may want to pursue, were also not too familiar with the strict CBT certification system but rather the traditional grading and certification systems. This situation created an uncertainty about the immediate acceptance of the strict CBT certification system by the employers and educational institutions offering higher degree programmes, therefore leading to an adoption of the traditional grading system in the adapted CBT model for the programme.

One other challenge, especially in transiting towards a strict CBT model, is logistics and infrastructure. More resources were required to intensify the participation of industry in the training of students by way of more frequent visit of students to industry aside the internship period as well as more frequent visit of industry practitioners to the campus to participate in training sessions and interaction with students. Intensifying practical and simulation sessions on campus also calls for more logistics and infrastructure than was available.

6. Conclusion

The introduction of the B-Tech (Building Technology) programme at the Sunyani polytechnic was not only meant to provide an opportunity for the academic progression of HND graduates in Building Technology and allied programmes like Civil Engineering and Estate Management, but to also train graduates to contribute to the growth of the construction industry. The CBT model was adopted in the implementation of the programme. After a number of consultations with stakeholders and reviewing CBT practices in some countries it was established that the environment was not supportive for the implementation of a strict CBT model. An adapted version of CBT, which is basically a hybrid blending aspects of the traditional system with aspects of CBT, was therefore adopted.

Some of the key elements of CBT that was introduced in the programme included courses like integrated project and workshop practice in the first semester, the internship session in the second semester, the use of teaching methods like problem based learning, group discussion and peer teaching, and the use of assessment methods like presentations, coursework, assignments and interviews. Graduates of the B–Tech (Building Technology) have admitted that going through the programme has led to an eventual enhancement in their professional competence. This situation has been corroborated by their employers who see them to have become more confident and professional in the performance of their job tasks. The internship component of the training is one of the key contributors to the building of a strong professional competence in the graduates. The CBT model therefore remains a worthy tool towards providing industry with professionally competent graduates, especially in the area of technology training, albeit the intense time and resource demands of the model.

Even though some form of training has been given to staff in the area of CBT, a lot needs to be done especially if there has to be a transition from the adapted model of CBT to the strict model. Transiting towards a strict CBT system will also require making the CBT system, especially the grading and certification schemes, more familiar to employers and institutions of higher training offering graduate programmes like M-Tech and MSc.

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