Research Paper

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Innovations in Building Technology and Curriculum Revision Needs of Colleges of Education (Technical) in Nigeria

Education

KEYWORDS : Innovations, Building Technology, Curriculum revision needs, Colleges of Education (Technical).

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ABSTRACT

The study was designed to determine the technological innovations in Building Construction in Colleges of Education (Technical). The study is a descriptive survey conducted in South-east geographical zone of Nigeria. It covered all the Colleges of Education (Technical) that run Building Technology programme. A structured questionnaire, based on the research questions, was used for data collection. The instrument was face-validated and tested for reliability using Cronbach Alpha and a reliability coefficient of 0.98 was obtained. The population of 97 respondents comprised 11 Building Technology teachers and 86 building personnel. Mean was used to answer the research questions while t-test was also used to test the hypothesis at 0.05 level of significance. The study found that technological innovations in Building technology include: Automated Building Diagnostic Software (ABDS), Active Window Insulation, Passive Solar Building Design, Computer-Aided Design/Drafting and Advanced Structural Design Software Methods. It was recommended that the Building Technology Curriculum in Colleges of Education (Technical) be reviewed in line with the technological innovations.

1. INTRODUCTION

The ability of any nation to create wealth and jobs coupled with its standing in the committee of nations in terms of self-reliance depends on its prowess in technology and availability of skilled, well trained labour force, especially in the field of science and technology. Technology is the systematic application of scientific or organized knowledge to practical tasks (Olujide, 2000). Technology involves all the know-how related to design and construction of products, manufacture, maintain and manage facilities. Technology therefore embodies products, processes and people. Technology changes from time to time as long as human beings continue to study the environment and come out with new inventions, ideas, methods and processes. These changes connote innovations. Hence, technological innovations incessantly transform production and consumption as well as organization of firms and industries.

1.1a Definition of Variables- Technological Innovation

Technological innovation refers to the process in which a new idea is embodied in tools, devices or procedures that are of practical value to society (Tornatzky and Lemer 1992). It may also be the re-organization of production, internal functions or distribution arrangements leading to increased efficiency, better support for a given product or lower costs. Technological innovations often involve tools and procedures, products and processes interacting in new ways. Wahab (2005) stated that as a result of the fast rate of technological innovations, new equipment is replacing old ones and new occupations are also springing up. This implies that programmes in Colleges of Education (Technical) need to be expanded to include new occupations and provide training on the new technologies.

Technical Education is that aspect of the educational process involving in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (UNESCO, 2000; FGN 2004). Technical Education includes specialized areas of Industrial Education such as Building technology.

1.1b Building Technology

Buildings, being life's necessity, are the nation's most valuable assets, providing people with shelter and facilities for work and leisure (Amobi, 2006). Onwuka (2005) defined building as the erection and maintenance of any structure in which people work or dwell. Building is a structure which has roof and walls (Anaele, 2010). Hence, Building Technology involves the technical methods, skills, processes, techniques, tools and raw materials needed for the erection and maintenance of buildings.

Building Technology has changed dramatically due to numerous innovations in technology. According to Tornatzky and Lemer (1992), many building construction industries involve software and hardware technologies. Nesler (2000) stated that the changes are accelerating at a fast rate. These changes, however, are driven by rapid growth in innovations such as Automated Building Diagnostic Software (ABDS), Active Window Insulation (AWI) and Passive Solar Building Design (PSBD).

Automated Building Diagnostic Software is a technology introduced to optimize the operation of heating, ventilation and air-conditioning (HVAC) equipment through computerized monitoring and control of HVAC in large commercial buildings. It is a digital control for heating and cooling systems. Active window insulation is the use of Automated Venetian Electric Lighting System as a day lighting strategy which offers potential savings in both lighting and cooling related to energy use. Passive solar building design is a design process that aims at maintaining interior thermal comfort throughout the daily and annual cycles whilst reducing the requirement for active heating and cooling acquisition.

However, changes in the design and construction of buildings, improvements in existing materials and the introduction of new materials have historically gone hand in hand (Anaele, 2010). It then implies that current design, construction materials and techniques may not be suitably handled and applied if proper care is not taken to address the problems associated with the introduction of new materials, methods and processes. Therefore, these innovations will definitely pose a lot of challenges to Building Construction Programmes in Colleges of Education (Technical).

1.1c College of Education (Technical)

College of Education (Technical) is an aspect of Technical Education with the primary role of producing middle level personnel for commerce, industry, agriculture, healthcare and teaching. According to the National Commission for Colleges of Education (NCCE) (2002), the philosophy of Colleges of Education (Technical) is to produce technical teachers with the intellectual and professional background adequate for teaching technical subjects and to make them adaptable to any changing situations in technological development not only in the country but also in the world at large. More so, some of the graduates of these colleges are sent to other countries of the world under the Technical Aids Corps (TAC). Therefore, the degree of success of these Colleges in achieving these challenges depends, not only on the number of skilled people they can turn out, but more on the depth of the skills and the degree of relevance of these skills to the prevailing situations. Nevertheless, the depth and relevance of the skills invariably depend on the curriculum used for the programme.

1.1d Curriculum Revision Needs

The curriculum is the guiding framework for school activities. Ogwo and Oranu (2006) defined curriculum in Technical and Vocational Education (TVE) as the totality of experiences, knowledge, skills and activities systematically planned to educate the students for gainful employment in any chosen occupation. However, for the curriculum of any programme to be relevant to prevailing situations, there is need for such curriculum to be revisited and reviewed as the need arises. Hence, curriculum revision involves the periodic review, improvement or changes of the curriculum content, learning experiences and objectives to relate to the needs of the time. According to Ogwo and Oranu (2006), the review is undertaken to forestall any crises of relevance between the needs of society and the demands of the curriculum. When there are new aims of education arising from changes in cultural beliefs, values, ideals and the philosophy of the society, the learning objectives, content and methods of delivery subsequently change. The need for curriculum revision of Building Technology Programmes in Colleges of Education (Technical) is of paramount importance. Finch and Crunkilton in Keiser, Lawrence and Appleton (2004) stated that the success of Technical Education curricula is not only measured by students' achievement in school, but also through the results of that achievement in the world of work. Therefore, the curriculum must be oriented and justified by both process (learning experiences within the school setting) and the product (employment opportunities derived from in-school experiences). They suggested that the curricula must be simultaneously justified by industry, yet remain pedagogically focused. This implies that the curriculum must directly help students develop a broad based range of knowledge, skill, attitudes and values that clearly contribute to the graduates' employability. To accomplish these tasks successfully, the curricula must be based on standards and also responsive to the technological changes in the society.

2. State of the Problem

Developing nations need efficient services of skilled technical personnel who have received formal training from technical institutions. The building construction industry is currently experiencing a paradigm shift from the traditional paper-based and muscle power to digital-based information exchange, analytical reasoning and creativity. The innovations in Building Technology such as Automated Building Diagnostic Software (ABDS), Active Window Insulation (AWI) and Passive Solar Building Design (PSBD) are lacking in Building Technology curriculum of Colleges of Education (Technical). The curriculum is not sufficiently attuned to building technology skilled labour demands, more especially now that the programme graduates will face the same labour market as other Building Technology graduates from other tertiary institutions in Nigeria in particular and the world in general. The study is therefore designed to determine the innovations in Building Technology and curriculum revision needs in Colleges of Education (Technical) in Nigeria

Research Questions

Four research questions guided the study:

1. What are the technological innovations in Building Construction industry?
2 What are the skills required in the study of the new technologies in Building Construction?
3. What are the facilities for studying the technological innovations in Building Construction?
4. What are the content areas that need to be reviewed in the curriculum of Building Construction in Colleges of Education (Technical)?

Hypothesis

One null hypothesis was tested at 0.05 significant level There is no significant difference in the mean responses of building industry staff and Building Technology teachers in what constitutes technological innovations in Building Construction.

3. Method

The study adopted a descriptive survey research design. In descriptive survey, detailed descriptions of existing phenomena are collected with the intent of using the data to justify current conditions and practices or to make better plans for improving phenomena (Ezeji, 2004). The descriptive survey research is employed to determine the extent to which current school practices meet the required standards in the industry.

The study was conducted in the South-east geo-political zone of Nigeria. The zone comprises Abia, Anambra, Ebonyi, Enugu and Imo States. The South-east zone has Colleges of Education (Technical) offering Building Technology according to the National Commission for Colleges of Education (NCCE) (2000). There are also building construction industries with the state of art facilities in the zone.

The population for the study was 97. This comprised 86 building professionals in the 28 reputable construction industries in the zone and 11 Building Technology Lecturers from the three Colleges of Education (Technical) that run Building Technology programmes. No sampling was carried out since the population is not too large that it cannot be managed.

3.1 Instrument for Data Collection

The instrument used for data collection was a structured questionnaire that was developed after review of available literature on innovations in Building Technology and Curriculum. The instrument was based on the research questions that guided the study, and on five-point Likert scale of Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree with assigned numerical values of 5, 4, 3, 2 and 1 respectively.

The instrument was face-validated by three University Lecturers of Building Technology and also tested to establish the reliability and a reliability with Crobach Alpha coefficient of 0.98 was obtained.

The instrument was administered personally by the researcher with the assistance of three trained research assistants. Out of the 97 copies of the questionnaire administered on the respondents, 86 copies were collected and used for data analysis.

The data collected on the research questions were analyzed using mean and standard deviation while the t-test was used to test the null hypothesis at 0.05 level of significance. Based on five-point scale, any item with mean of 3.50 and above is agreed upon while any item with mean below 3.50 is disagreed upon. Also, if the calculated t-value exceeds the table value, the null hypothesis was rejected, but if the calculated t-value is less than the table value, the null hypothesis was accepted.

Results

Table 1: Mean and Standard Deviation of the Respondents' Responses on Technological Innovations in Building Construction Industry *N*=86

S/N	Item	X	SD	Remark
1	Automated Building Diagnostic Software (ABDS)	4.64	0.55	Agree
2	Active Window Insulation (AWI)	4.25	0.57	Agree
3	Passive Solar Building Design (PSBD)	4.02	0.80	Agree
4	Computer Aided Design/Drafting (CAD)	4.85	0.33	Agree
5	Advanced Structural Design Software			
	Methods	4.48	0.61	Agree

Table I shows that the respondents agreed that all the items are technological innovations in building construction industry. Their mean responses range between 4.02 and 4.21, with Standard Deviation from 0.33 to 0.43 showing that the respondents are not far apart from their responses.

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Table 2: Mean and Standard Deviation of the Respondents' Responses on the Skills Required in the Study of Technological Innovations in Building Construction
N = 86

S/N	Ability to:	X	SD	Remark
1	Read and interpret major terms used in building automation (Whole Building Diagnostic).	4.78	0.42	Agree
2	Operate automated data collection.	4.18	1.00	Agree
3	Read and interpret display results by user interface (UI) and symbols.	4.50	0.65	Agree
4	Diagnose and trouble shoot.	4.62	0.49	Agree
5	Control and track systems in the software.	4.50	0.49	Agree
6	Carry out installation and commissioning of automated building diagnostic software work.	4.32	0.47	Agree
7	Use computers and related software in Building Construction scheduling, database and programming.	4.68	0.61	Agree
8	Read and interpret innovations in drawing.	4.85	0.20	Agree
9	Use Computer Aided Design/ Drafting (2D, 3D, 4D).	4.80	0.41	Agree
10	Operate venetian blinds that actively optimize day zone of buildings.	4.02	0.77	Agree
11	Control and adjust automated venetian blind to any desired position.	4.57	0.77	Agree
12	Position sensor and incorporated data in venetian blind control software.	4.28	0.65	Agree
13	Recognize the core physical environmental and scientific principles involved in the passive solar building design.	4.08	1.09	Agree
14	Achieve the goals of solar path fundamentals in passive solar building design.	3.96	0.60	Agree
15	Specify latitude and sun path in site consideration during design.	4.59	0.75	Agree
16	Recognize micro-climatic details related to breezes, humidity, vegetation, and land contour during design.	4.39	0.66	Agree
17	Design building to face the equator or a few degrees to the east to capture the moving sun.	4.18	0.79	Agree
18	Place windows during design to face midday sun in the winter and be shaded in the summer.	4.11	0.67	Agree
19	Design a cool or green roof.	4.50	0.79	Agree
20	Recognize that thermal energy can be stored in certain building materials and released when heat gain ceases.	4.26	0.91	Agree
21	Interpret maintenance problems identified by the computer.	4.76	0.43	Agree

Table 2 indicates that the respondents agree that all the skills are required in the study of technological innovations in Building Construction. Each item's mean score is more than 3.50 and the Standard Deviation of the items are close to the mean.

Table 3:Mean and Standard Deviation of the Respondents' Responses on the Facilities for Studying the Technological Innovations in Building Construction
N = 86

S/N	Facilities	X	SD	Remark
1	Multi-media laboratory/ classroom.	4.44	0.66	Agree
2	Multi-media hardware and software.	4.71	0.46	Agree
3	Good lighting and ventilation systems.	4.73	0.45	Agree
4	Automated heating, ventilation and air conditioning equipment.	4.40	0.56	Agree
5	Programmable logic Controllers (PLCs)	4.22	0.85	Agree
6	Computer Numerical Control (CNC)	3.96	1.02	Agree
7	Robots, hand held computers for constructing records, inspections, material testing and quantity tracking.	4.36	0.75	Agree
8	Model drawing studio.	4.75	0.43	Agree
9	Model classroom/laboratory.	4.46	0.69	Agree
10	Heating, ventilation and air-conditioning components.	4.24	0.58	Agree
11	Photo sensor and prototype sun sensor.	4.11	0.80	Agree
12	Venetian Blinds.	4.09	0.77	Agree
13	Florescent lighting with dimmable electronic ballasts	4.38	0.65	Agree
14	Energy saving florescent light and bulbs.	4.38	0.60	Agree
15	Energy monitoring and control systems	4.40	0.56	Agree
16	Reliable internet connectivity.	4.72	0.52	Agree

The facilities for studying the technological innovations presented in table 3 are all agreed upon by the respondents, as indicated by their means between 3.96 and 4.09 and Standard Deviation 0.45 to 1.02.

Table 4: Mean and Standard Deviation of the Respondents' Responses on the Content Areas that Need to be Reviewed in the Curriculum of Building Construction in Colleges of Education (Technical)
N = 11(Building Construction Lecturers)

S/N	Content areas	X	SD	Remark
1	Introduction to Building Construction.	4.63	0.79	Agree
2	Building science and materials technology.	4.55	0.66	Agree
3	Construction methods I and II.	4.73	0.45	Agree
4	Elementary Structural Design	4.64	0.64	Agree
5	Students Industrial Work Experience Scheme (SIWES)	4.36	0.98	Agree
6	Entrepreneurship in Technical and Vocational Education.	4.00	1.04	Agree
7	Land Surveying.	4.18	0.93	Agree
8	Practical Projects.	4.45	1.16	Agree
9	Building Drawing.	4.45	0.89	Agree
10	Building Maintenance/Repairs.	4.45	0.89	Agree
11	School workshop management	4.36	0.98	Agree
12	Mechanical Engineering Drawing.	4.18	0.71	Agree

Table 4 shows the responses of the Building Technology Lecturers on the content areas that need to be reviewed in the curriculum of Building Construction in Colleges of Education (Technical). The mean (4.00 – 4.73) and Standard Deviation (0.45 – 1.16) of their responses prove that they agreed on all the items.

Table 5: t-Test Analysis of Respondents' Responses on What Constitutes Technological Innovations in Building Construction
N1 = 11-Building Technology Lecturers
N2 = 75- Building Construction Personnel

S/N	Item	X_1	SD_1	X_2	SD_2	t - cal	Remark
1	Automated Building Diagnostic Software (ABDS)	4.73	0.45	4.55	0.64	1.06	NS
2	Active Window Insulation	4.45	0.50	4.04	0.64	2.40	S
3	Passive Solar Building System	4.00	0.85	4.04	0.75	-1.04	NS
4	Computer-Aided Design/Drafting (CAD)	5.00	0.00	4.69	0.47	0.00	NS
5	Advanced Structural Design Software/ Methods	4.27	0.75	4.69	0.47	-1.9	NS

Note: t – table = 1.96 at 0.05 level of significance and degree of freedom (df) 84.

Data presented in table 5 show that there is significance difference in the responses of the respondents on item no 2 (Active Window Insulation).

4.1 Discussion
The findings show that what constitutes the technological innovations in Building Technology include Automated Building Diagnostic Software (ABDS). Active Window Insulation, Passive Solar Building Design, Computer-Aided Design/Drafting and Advanced Structural Design Software/Methods (Aliyu, 2003; American Council of Energy Economy, 2004; Sheikh, 2004). Computer-aided Design/Drafting has the highest mean of 4.85 and Standard Deviation of 0.33. This supports Wikipedia (2009) that CAD has become an especially important technology with benefits such as lower product development costs and greatly shortened design cycle. The findings also agree with Nesler (1998) who noted that changes in Building Technology are driven by rapid innovations such as Automated Building Diagnostic Software, Active Window Insulation, and Passive Solar Building Design. The findings are also in line with Qureshi (2008) who stated that technology can be used in designing sustainable buildings as long as they adhere to the basic principles of sustainability. Energy could be saved through efficient lighting systems by integration of day efficient lamps and luminaries, and use of light demand simulators and controls to eliminate wastage (Rheault and Bilgen, 1990; United States Department of Energy, 2006; Katipamular, Brainbley, Bauman, and Pratt, 2008).

However, the significant difference in the mean responses of Building Technology teachers and building construction personnel on Active Window Insulation does not indicate non-technological innovation. It may be due to differences in their practical exposure.

The skills required in the study of the technological innovations in Building Technology as presented in Table 2 are all agreed upon by the respondents. The findings corroborate with Keiser, Lawrenz and Appleton (2004) that the success of Technical and Vocational Education curricula is not only measured by students' achievement in school, but also through the results of that achievement in the world of work. Curricula must be oriented and justified by both process (learning experiences within the school setting) and the product (employment opportunities derived from in-school experiences). Also it must be simultaneously justified by industry, yet remain pedagogically focused. This implies that the curricula must directly help students develop a broad range of knowledge, skills, attitudes and values that clearly contribute to the graduate's employability.

The facilities for studying the technological innovations in Building Technology as presented in Table 3 are all agreed upon by the respondents. Algozzine, Bateman, Flowers, Gretes, Hughes and Lambert (1999) stated that such facilities are necessary for developing theoretical and practical competencies in Building Technology in Colleges of Education (Technical). The findings on facilities are in line with Brown and Harnish (2001) who stated that industries (Building industries inclusive) will continue to record more technological breakthroughs in both procedures and treatment. This implies that Building construction facilities/equipment will become more and more automated through the use of computers.

As regards the content areas to be reviewed in the curriculum of Building Construction in Colleges of Education (Technical), the teachers agreed that curriculum of Building Construction be reviewed to make it relevant to the current technological innovations. Based on the current state of changing needs of societies and the work place, new knowledge and technologies are altering the skills required for production, maintenance and repairs. The findings are in line with Arayela (2002) who noted that modern building industries lay much emphasis on sophisticated building materials and techniques. According to Adedeji (2002), standard designs, production of components and new techniques in fabrication result to mass production of affordable housing units with emphasis on walling and roofing materials.

4.2 Conclusions and Recommendations
As technological innovation is continuous, the skills possessed by Building Technology graduates are no longer adequate to measure up with the skill needs of the industry. The Building Technology curriculum in Colleges of Education (Technical) lacks the essential rudiments of technological innovations. In order to develop professional abilities in the students, involvement of field/site experts must be increased in curriculum design, implementation and assessment of students.

The curriculum of Building Technology in Colleges of Education (Technical) should be reviewed in line with technological innovations.

Seminars, workshops and conferences should be organized for Building Technology teachers on technological innovations in building construction.

The curriculum of teacher preparation institutions should be reviewed to accommodate technological innovations.

Building Technology students should be taken to construction sites for exposure to technological innovations.

Resource persons in Construction Technology should always be invited to give lectures to the students on technological innovations.

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REFERENCE

Adedeji, Y. M. (2002). Achieving affordable housing in South-west Nigeria through local building material. Journal of Environmental Technology Federal University of Technology, Akure, 1, 2, 15-21. | | Algozzine, B., Bateman, L. R., Flowers, C. P., Gretes, J. A., Hughes, C. D & Lambert, R. (1999). Developing technology competencies in a College of Education. Current Issues in Education Retrieved on June 18, 2009 from http://cu.asu.edu/volume2/number3/index.html | Aliyu, M. M. (2003). Innovation and technology building systems: the case of intelligent buildings. Proceeding of the millennium conference of building. Ahmadu Bello University. | | American Council for Energy- Efficient Economy (2004). Automated Building Diagnostics Software (ABDS). Emerging Technologies and Practice: ACEEE. | | Amobi, C. O. (2006). Fundamentals of building maintenance technology and management. Owerri: Achugo Publications. | | Anaele, E. O. (2010). Problems of building construction in Nigeria. Ebonyi Technology and Vocational Education Journal. Ebonyi State University, Abakaliki, 1 (1), 61 – 70. | | Arayela, O. (2002). Increasing housing stock at reduced cost in Nigeria. Association of Architectural Educators in Nigeria Journal (AARCHES) 2 (2) 18-24. | | Brown, T. & Harnish, D. (2001). New programme directions for Georgia technical colleges; Stakeholders views of emerging programme and labour market needs report prepared by Occupational Research Group School of Leadership | and Lifelong Learning, College of Education, University of Georgia. | | Ezeji, S. C. O. A. (2004). Basic principles of research in education. Enugu: Cheston Agency Ltd. | | Federal Government of Nigeria (FGN) (2004). National Policy on Education. Lagos: Nigerian Educational Development Council. | | Katipamular, S., Brambley, M. R., Bauman, N. N. & Pratt, R.G. (2008). Enhancing building operations through automated diagnostics; field test report. Retrieved on April 1, 2008 from http://www.buildingsystem.sprogram.pnl.gov/fdd/publications/PNNL- 39693.pdf | | Keiser, J. C., Lawrenz, F. & Appleton, J. J. (2004). Technical education curriculum assessment, Journal of Vocational Education Research 29 (3) 181-194. | National Commission for Colleges of Education (2002). Annual report. Abuja: NCCE. | Nesler, C. G. (2002). Heating, piping and air-conditioning. Hillsdale: Lawrenz Egilbaum. | | Ogw0, B. A., & Oranu, R. N. (2006). Methodology in formal and non-formal technical/vocational education. Enugu: University of Nigeria Press Ltd. | Olujide, A. (2000). The emerging constraints of the objectives of vocational technical education. In Eyibe (Ed). Philosophy of technology education. Onitsha: Adison Educational Publishers. | | Onwuka, G. M. (2005). Relevance and functionality of building technology education in national development, In G.O. Adindu (Ed), Abia State University Journal of Construction Management and Building (ABSU-JCMB) 1 (1), 70-76. | | Qureshi, S. (2008). Conferences and exhibition report. International seminar on sustainable building. Liverpool GBER 6 (3), 66-70. | | Rheault , S. & Bilgen, E. (1990). Experimental study of full-size automated venetian blind windows, solar energy. In Rutgers New Brunswick/Piscataway Campus Retrieved July 8, 2009. | | Sheikh, G. A. (2004). Curriculum of architecture. Retrieved on November 25, 2008 from http://20.80.244.196/Academic Affairs/Curriculum Revision/downlaod/2004/Architecture.final.doc | | Tornatzky, L.G., & Lemer, A.C. (1992). Processes of technological innovation. The role of public agency fostering new technology and innovation in building commission on engineering and technical systems (CETS). Washington D. C. National Academy Press. | | UNESCO & ILO (2002). Technical and vocational education and training for the twenty- first century. UNESCO and ILO recommendations Retrieved on September 13, 2004 from http://www.unesco.org/education or http://www.ilo.org/skill | | United States Department of Energy (2006). Passive solar building design. Retrieved on March 16, 2009 from www.eree.energy.gov. | | Wahab, K. A. (2005). Due process, the construction industry and the builders. In the Nigerian Institute of Building Proceedings Annual Conference. | | Wikipedia, the free encyclopedia – passive solar building design. Retrieved on March 16, 2009 from www.greenbuilder.com | | | |