ii. With the essential knowledge and skill that will enable him perform completely all aspects of brickwork in the construction industry.

iii. With the essential knowledge and skill that will enable him perform proficiently all aspects of block layers work in the construction industry.

iv. With the basic knowledge of the properties and applications of concrete as well as the skills in the production of sound concrete structures.

v. With the basic knowledge of finishing materials related to the buildings work and to enable him apply such finishes proficiently.

vi. With the basic knowledge and skills of plumbing for water services in building.

According to Federal Republic Nigeria on National Policy on Education (FRN, 2013), TVET is defined as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practice skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. The goals of vocational-technical education shall be to provide trained manpower in applied sciences, technology and business particularly at the craft, advanced craft and technical levels. Provide the technical knowledge and vocational skills necessary for Agricultural, Commercial and Economic development, acquire technical and vocational skills. Give training and impart the necessary skills to the individual who shall be self-reliant economically. Hence, these objectives listed are drives by the formal vocational institutions in Nigeria such as polytechnics, mono technics and technical colleges (National Board for Technical Education, 2013).

Building Drawing and Design is a technical drawing of a building (or building project) that falls within the definition of architecture. Architectural drawings are used by architects and others for a number of purposes: to develop a design idea into a coherent

proposal, to communicate ideas and concepts, to convince clients of the merits of a design, to assist a building contractor to construct it based on design intent, as a record of the design and planned development, or to make a record of a building that already exists (Gary & Bertoline 2002). Building drawing and design are made according to a set of conventions, which include particular views (floor plan, section etc.), sheet sizes, units of measurement and scales, annotation and cross referencing.

The size of drawings reflects the materials available and the size that is convenient to transport – rolled up or folded, laid out on a table, or pinned up on a wall. The drafting process may impose limitations on the size that is realistically workable. Sizes are determined by a consistent paper size system, according to local usage. Normally the largest paper size used in modern architectural practice is ISO A0 (841 mm × 1,189 mm or 33.1 in × 46.8 in) or in the USA Arch E (762 mm × 1,067 mm or 30 in × 42 in) or Large E size (915 mm × 1,220 mm or 36 in × 48 in) (Richard & Fred 2004).

Building drawings are drawn to scale, so that relative sizes are correctly represented. The scale is chosen both to ensure the whole building will fit on the chosen sheet size, and to show the required amount of detail. At the scale of one eighth of an inch to one foot (1:96) or the metric equivalent 1 to 100, walls are typically shown as simple outlines corresponding to the overall thickness. At a larger scale, half an inch to one foot (1:24) or the nearest common metric equivalent 1 to 20, the layers of different materials that make up the wall construction are shown. Construction details are drawn to a larger scale, in some cases full size (1 to 1 scale).

Job is a paid position of regular employment. It is a regular activity performed in exchange of payment. It consists of duties, responsibilities and tasks that are specific, and can be quantified, measured and rated. To display an expertise in a job, skill is needed. It is for

this reason that the FRN (2013) emphasized technical vocational education and training (in which block-laying and concreting is an aspect) in her educational system to inculcate skills in the students. Block-laying and concreting was incorporated into the curriculum of technical colleges in order to facilitate the attainment of the objectives on block-moulding, block-laying and concreting works NBTE, (2004) Block-laying and concreting works is a skill-oriented field of study noted for its capability of equipping learners with saleable skills for self-reliance and also paid employment. Block-laying and concreting work is one of the areas of specialization taught in technical colleges at the intermediate and advanced levels in Nigeria. This programme deals with the acquisition of skills and techniques in block-moulding, block-laying and concreting works/occupations to enable an individual earn a living. Skills are acquired to enable the recipient take the best of his/her physical, community and political environment (Dokubo, 2017). Block-laying and concreting work is predicated upon the teaching of skills and also demanding the professional use of hands. It is designed to equip students with skills required towards the production of educated persons who can effectively work with their brain and hands.

Instructional Design is simply the step-by-step procedure for creating instructional materials in a consistent and reliable manner in order to enhance teaching and learning. The various terms and definitions used to refer to instructional design (example; instructional design, instructional development, educational/ instructional technology, and instructional systems development/design) reflect the theoretical assumptions and practical descriptions of instructional design. Crawford (2004) opined that, instructional design is the distinct systematic process through which evolves a superior instructional product as delineated through an instructional design model. It guides designers to work more efficiently while producing more effective and appealing instruction suitable for a wide range of learning environments. According to Abdu-Raheem (2011) instructional design

augments learning by incorporating various strategies into courseware, for example structuring, ordering and sequencing content in particular ways, depending on the expected learning outcome.

Statement of the Problem

The goal of technical education is to prepare its beneficiaries with all it takes to adjust well in the societies, contribute meaningfully to the development of the society and as well live a fulfilled life (Eze, Ezenwafor & Molokwu, 2015). This is in line with the goal of Brick/Block-laying and concreting at Technical college level which is designed to provide the trainee with the essential knowledge and skill that will enable him perform competently in all aspects of Brick-work in the construction industry. On completion of the programme, the trainee ought to manipulate various tools and equipment in the brick/block laying and concreting trade. Manipulative skills are required in brick/ block laying and concreting.

Unfortunately, the above is far from being achieved as the result of NABTEB examinations shows poor performance of technical students (Oyenuga, 2019). There is a common believes by general public and most especially the employers of labour that technical college products are incompetent, half-baked and have inadequate practical skills. Tebabal and Kahssay (2011), state that poor performance of many technical colleges' students may be attributed to neglect, poor funding, and inadequate resources and inappropriate teaching methods. The shortcoming in this teacher-centered method of teaching could be responsible for poor achievement of students in public examinations (NABTEB 2002). The above necessitated the study of 3D printed Architecture Model on Students Performance in Brick/Block Laying and Concreting Programme. The question is would the use of 3D printed Architecture Model improve Students' performance in Brick/Block Laying and Concreting Programme? Answers to this question gave rise to the

study of Influence of 3-Dimensional printed Architecture Model on Students performance in brick/block laying and concreting programme in Technical colleges in Rivers State.

Purpose of the Study

The general aim of the study is to determine the Influence of 3-Dimensional Printed Architecture Model on Students performance in brick/block laying and concreting programme in Technical colleges in Rivers State. Specifically, the study explored:

1. Influence of 3-Dimensional Printed Architecture Model on Students Performance in Building Drawing and Design in Technical colleges in Rivers State.
2. Influence of 3-Dimensional Printed Architecture Model on Students Performance in Brick Laying in Technical colleges in Rivers State.
3. Influence of 3-Dimensional Printed Architecture Model on Students Performance in Block Laying in Technical colleges in Rivers State.

Research Questions

The following research questions were posed for the study

1. What is the Influence of 3-Dimensional Printed Architecture Model on Students Performance in Building Drawing and Design in Technical colleges in Rivers State?
2. What is the Influence of 3-Dimensional Printed Architecture Model on Students Performance in Brick Laying in Technical colleges in Rivers State?
3. What is the Influence of 3-Dimensional Printed Architecture Model on Students Performance in Block Laying in Technical colleges in Rivers State?

Hypotheses

The following hypotheses were formulated and tested at .05 level of significance

1. There is no significant difference in the mean scores of students taught building drawing and design using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.
2. There is no significant difference in the mean scores of students taught brick laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.
3. There is no significant difference in the mean scores of students taught block laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Method

The study adopted a quasi-experimental pre-test, post-test design with experimental and non-equivalent groups. A quasi-experimental research design involves exposure of experimental group to treatment but lacks the randomization of the research subjects into groups (Wodi, 2005). The researcher felt that use of a quasi-experimental research design was suitable for the study. The area of the study was Rivers State which comprise of all Government Technical Colleges in Rivers State of Nigeria. There are four Government Technical Colleges (GTC) in Rivers State and it involved GTC, Ahoada; GTC, Ogubolo; GTC, Port Harcourt and GTC, Tombia. The population for the study comprised 90 National Technical Certificate (NTC) II Block-laying/Bricklaying and concreting students in the two technical colleges in Rivers State selected for the study. The study sample comprised of 90 students and simple random sampling technique was used to select two technical colleges out of the four technical colleges in Rivers State. The instrument for data collection was Block-laying/Bricklaying and concreting Achievement Test (BTAT) which has sections outlined and was used to elicit information from the respondents. The development of the BTAT entails constructed test items on the brick/block laying and

concreting craft topics which were covered in the study: building drawing/design, bricklaying and block-laying on the weight of the unit coverage at 20% each. Validation was done by three experts in the field of education and one measurement and evaluation expert. The experts were given lesson plan and table of specification/test blue print as instrument and were subjected to face and content validation by the experts. Their inputs and corrections were taken into consideration before the final copies were produced by the researcher.

Reliability was done using test retest and Kuder Richardson formula 20 (KR-20) was used to obtain and index figure of 0.85 which was appropriate for the study. Two groups of the subjects were used to collect data for the study and its involved those taught with control technique and experimental teaching technique. In all, a total of 90 students were involved with typed test instrument of Brick Block Laying and Concreting Achievement Test and administered to the students after this both group were taught brick block laying and concreting for a period of three weeks with three lesson plan which took three weeks periods with extraneous variable employed on initial group difference, experimental bias, teacher variables, variability of instructional situation, effect of pre and post-test and training of teachers and analysis were done using mean and standard deviation and hypotheses were tested using ANCOVA at .05 level of significance. Decision for the hypotheses was that any f-ratio equals to or greater than the table or critical f-value, the null hypotheses were rejected and any f-ratio less than the critical f-ratio was accepted.

Results

The results for this study were done according to each research question posed in the study

Research Question 1: What is the Influence of 3-Dimensional Printed Architecture Model on Students Performance in Building Drawing and Design in Technical colleges in Rivers State?

Table 1: Mean and Standard Deviation of Control and 3D printed Architecture Mode Teaching Techniques on Students' Achievement in Building Drawing/Design

Group	School	N	Pre-test		Post-test		Mean-Gain
			$\overline{X}$	SD	$\overline{X}$	SD	
Treatment	GTC Ahoada	50	15.60	3.14	32.07	2.98	17.1
Control	GTC PH	40	16.50	3.40	26.50	3.43	10

Source: Field Survey, 2021

Table 1 showed the pre-test and post-test mean score of students' performances in building drawing/design for both experimental and control groups. Result shows that the students in the experimental group had a pre-test mean score of 15.60 with a standard deviation of 3.14 and a post-test mean score of 32.07 with a SD of 2.98. The difference between the pre-test and post-test mean for the experimental group was 17.1, while the control group had a pre-test mean score 16.50 with a standard deviation of 3.43 and a post-test mean score of 26.50 and SD of 3.43. This shows that the mean score for the experimental group is higher than the control group, indicating that those taught with the experimental teaching technique performed better in building drawing and design in Technical colleges in Rivers State.

Research Question 2: What is the Influence of 3-Dimensional Printed Architect Model on Students Performance in Brick Laying in Technical colleges in Rivers State?

Table 2: Mean and Standard Deviation of Demonstration and 3D Printed Architecture Model Teaching Techniques on Students' Achievement in Bricklaying

Group	School	N	Pre-test	Post-test	Mean-

							Gain
			$\overline{X}$	SD	$\overline{X}$	SD	
Experimental	GTC Ahoada	50	14.21	3.49	31.85	4.48	17.64
Control	GTC PH	40	15.00	3.55	24.75	3.99	9.75

Source: Field Survey, 2021

Table 2 shows the pre-test and post-test mean score of students' performances in bricklaying for both experimental and control groups. Result shows that the students in the experimental group had a pre-test mean score of 14.21 with a standard deviation of 3.49 and a post-test mean score of 31.85 with a SD of 17.64. The difference between the pre-test and post-test mean for the experimental group was 17.64, while the control group had a pre-test mean score 15.00 with a standard deviation of 3.55 and a post-test mean score of 24.75 and SD of 3.99. This shows that the mean score for the experimental group is higher than the control group, indicating that those taught with the experimental teaching technique performed better in Brick Laying in Technical colleges in Rivers State.

Research Question 3: What is the Influence of 3-Dimensional Printed Architecture Model on Students Performance in Block Laying in Technical colleges in Rivers State?

Table 3: Mean and Standard Deviation of Demonstration and 3D Printed Architecture Model Teaching Techniques on Students' Achievement in Block-laying Skills

Group	School	N	Pre-test		Post-test		Mean-Gain
			$\overline{X}$	SD	$\overline{X}$	SD	
Experimental	GTC Ahoada	50	16.29	2.98	33.32	3.78	17.03
Control	GTC PH	40	15.50	2.14	25.58	2.04	10.08

Source: Field Survey, 2021

Table 3 shows the pre-test and post-test mean score of students' performance in block-laying skills for both experimental and control groups. Result shows that the students in the experimental group had a pre-test mean score of 16.29 with a standard deviation of 2.98 and a post-test mean score of 33.32 with a SD of 3.78. The difference between the pre-test and post-test mean for the experimental group was 17.03, while the control group had a pre-test mean score 15.50 with a standard deviation of 2.14 and a post-test mean score of 25.58 and SD of 2.04. This shows that the mean score for the experimental group is higher than the control group, indicating that those taught with the experimental teaching technique performed better in Block Laying in Technical colleges in Rivers State.

Hypotheses

Hypothesis 1: There is no significant difference in the mean scores of students taught building drawing and design using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Table 4: The Analysis of Covariance (ANCOVA) on Demonstration and 3D Printed Architecture Model Teaching Techniques on Students' Achievement in Building Drawing/Design

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	495.780[a]	2	247.890	29.113	.000
Intercept	1022.187	1	1022.187	120.050	.000
PRE-TEST	94.637	1	94.637	11.115	.002
GROUP	448.270	1	448.270	52.647	.000
Error	417.220	88	8.515		
Total	46166.000	90			
Corrected Total	913.000	89			

Source: Field Survey, 2021

The analysis of covariance of students' performance scores presented in Table 4 showed that f-calculated for teaching methods in the two groups is 52.647 at 0.000 significant level. It therefore implies that the null hypothesis is rejected. Thus, there is a significant difference in the mean scores of students taught building drawing and design using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Hypothesis 2: There is no significant difference in the mean scores of students taught brick laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Table 5: The Analysis of Covariance (ANCOVA) on Demonstration and 3D printed Architecture Model Teaching Techniques on Students' Achievement in Bricklaying

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	691.898[a]	2	345.949	19.467	.000
Intercept	1671.541	1	1671.541	94.058	.000
PRE-TEST_A	39.135	1	39.135	2.202	.144
GROUP	680.757	1	680.757	38.307	.000
Error	870.794	88	17.771		
Total	44028.000	90			
Corrected Total	1562.692	89			

Source: Field Survey, 2021

The analysis of covariance of student's performance scores presented in Table 5 showed that f-calculated for teaching methods in the two groups is 38.307 at 0.000 significant level. It therefore implies that the null hypothesis is rejected. Thus, there is a significant

difference in the mean scores of students taught brick laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Hypothesis 3: There is no significant difference in the mean scores of students taught block laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Table 6: The Analysis of Covariance (ANCOVA) on Demonstration and 3D Printed Architecture Model Teaching Techniques on Students' Achievement in Block Laying Skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	907.019[a]	2	453.510	63.722	.000
Intercept	482.309	1	482.309	67.769	.000
PRE-TEST_B	133.210	1	133.210	18.717	.000
GROUP	563.667	1	563.667	79.201	.000
Error	348.731	88	7.117		
Total	47279.000	90			
Corrected Total	1255.750	89			

Source: Field Survey, 2021

The analysis of covariance of students' performance scores presented in Table 6 showed that f-calculated for teaching methods in the two groups is 79.201 at 0.000 significant level. It therefore implies that the null hypothesis is rejected. Thus, there is a significant difference in the mean scores of students taught block laying using 3D printed Architecture Model and those taught using conventional teaching technique in Technical colleges in Rivers State.

Discussions of Findings

The findings of the study were discussed in line with research questions and hypotheses posed in the study. Students taught with the 3D printed Architecture Model teaching technique performed better than students taught with demonstration teaching techniques in building drawing/design in technical colleges in Rivers State. The finding is in line with Ekenta (2009) who stated that Carefully designed inquiry learning environments can assist students in the process of transforming information and data into useful knowledge" (Experimental teaching technique is often described as a cycle or a spiral, which implies formulation of question, investigation, creation of a solution or an appropriate response, discussion and reflection in connection with results).

Students taught with the 3D printed Architecture Model teaching technique performed better than students taught with demonstration teaching techniques in bricklaying in technical colleges in Rivers State. The finding is in agreement with Geral (2013) who viewed Experimental teaching technique as a means that teachers design situations so that pupils are cause to employ procedures research scientist used to recognize problems, and to ask questions, and to apply investigational procedures, and to provide consistent descriptions, prediction and explanations which are compatible with shared experience of the Building Technology world

Students taught with the 3D printed Architecture Model teaching technique performed better than students taught with demonstration teaching techniques in block laying skills in technical colleges in Rivers State. The finding is in accordance with Gilchrist (2013) who asserted that organizing learning using experimental teaching technique would enable teachers and students to integrate knowledge across the disciplines through the cultivation of disciplined habits of mind. Gilchrist (2013) was certainly ahead his time, and traces of his extensions exist today in our need to reaffirm a place for inquiry within our learning system.

Conclusion

Based on the findings of the study, the following conclusions are drawn. An 3D printed Architecture Model teaching technique for teaching skills in Block-laying/Bricklaying and concreting has been developed and its efficacy based on syllabus for technical colleges was tested. The mean performance of the students taught with the 3D printed Architecture Model teaching technique was better than those taught with demonstration teaching technique. This performance is consistent in all of the four Block-laying/Bricklaying and concreting skills and this cannot be said to have occurred by chance, but rather due to the effectiveness of the 3D printed Architecture Model teaching technique. Therefore, the 3D printed Architecture Model teaching technique for teaching Block-laying/Bricklaying and concreting skills has yielded better performance and should be used in teaching students in technical colleges in Nigeria.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. In line with the responsibility vested on practicing technical teachers in technical colleges for guiding students to improve their performance in Block-laying/Bricklaying and concreting, technical teachers should subject this newly developed technique to further try-outs in order to serve as means of further assuring its performance usefulness, and eventual adoption for continual use in teaching performance skills in Block-laying/Bricklaying and concreting.
2. Standardization and harmonization of programmes being part of the responsibilities of National Board for Technical Education (NBTE), this board should consider introducing 3D printed Architecture Model teaching technique as a standardized guide for the implementation of a uniform instructional strategy in Block-laying/Bricklaying and concreting in technical colleges.

3. In view of the dearth of instructional materials (textbooks, instructional guides, manuals, in technical and vocational education, the NBTE should undertake or support the production of the 3D printed Architecture Model teaching technique for use in technical colleges.

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