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Design and Implementation of Moodlecloud-Based Platform for Teaching and Learning Building Technology Course in Abia State College of Education (Technical), Arochukwu

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Abstract

The study designed and implemented a Moodlecloud-based Platform (MBP) for teaching and learning Building Technology (BT) course in Abia State College of Education (Technical), Arochukwu. The MBP was developed in the Moodlecloud platform (https://buildtech.moodlecloud.com/), which has a group of interactive tools that facilitate the inclusion of variety of teaching and learning activities. The design and implementation of MBP was based on the following stages: needs assessment, design of MBP platform, trial-testing MBP and implementation of MBP. The study employed Research and Development design. Mixed research approach involving the use of questionnaire and structured interview schedule, were utilized for data collection, and were analyzed and reported quantitatively and qualitatively respectively. The study was carried out in Abia State College of Education (Technical), Arochukwu, Abia State, Nigeria. The population for the study comprised 7 BT lecturers, 9 NCE year one students, 7 NCE year two students and 2 NCE year three students. At NCE years one and two, all the students offer BT course and then specialize at NCE year three. Purposive sampling technique was adopted to select only year three students who specialized in BT, to participate in the study while all the BT lecturers participated at the needs assessment stage. Three research questions were formulated to guide the study. The instruments used for data collection were the researchers' developed questionnaire for research question one and structured interview schedule for research questions two and three. The data collected for the study were analyzed using mean scores to answer research question one while an interview summary sheet was used to summarize the main findings of the interview schedule for research questions two and three. The findings of the study revealed that generally, the contents of the BT course are difficult; students were satisfied with MBP based on their expressions during the structured interview exercise. It was further revealed that cost of data subscription, workload from other courses, are among the challenges encountered in the online course. Therefore, it was recommended among others that school management and ministry of education should fund the hosting of courses in Moodlecloud-based platform since it has been proven to increase students' interest in teaching and learning especially in the BT course, in all Technical Colleges in Nigeria.

Keywords: Building Technology, Moodlecloud, Teaching and Learning, Learning Management System, Online Learning.

Introduction

The contributions of education to the growth of national economy have led to the campaign for improvement on the standard of education in Nigeria so as to sustain the benefits it offers especially in the modern world of digital technology. According to Nwangwu (2018), modern education systems all over the world hardly operate without the use of Information and Communication Technologies (ICTs) such as computers, smart phones, projection devices, internet facilities, among other digital devices. Bawaneh (2011) previously opined that computer technology has become an integral part of university education system especially in the instructional delivery

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process. This is evidenced during the outbreak of Covid19 pandemic that led to the lock down of the country including schools, which forced countries all over the world to adopt alternative means of instruction delivery. This new means of delivering instruction involves the use of internet applications such as zoom, social media, learning management systems (also known as online teaching and learning platforms), among others to prepare, present and assess students' learning achievement.

The internet has contributed immensely to the success of online education especially during the Covid19 lockdown. During the COVID-19 pandemic, over 1.2 billion children were out of the classroom and this resulted in schools shutting all across the world; as a result, education has changed dramatically, with the distinctive rise of e-learning, whereby teaching is undertaken remotely and on digital platforms (Li & Lalani, 2020). According to Li and Lalani, research suggests that online learning has been shown to increase retention of information, and takes less time, meaning the changes coronavirus have caused might be here to stay. There were a lot of applications that were developed and used for the purpose of teaching and learning during the Covid19 era. For example, Zoom, which is a very powerful video conferencing app, became highly significant and relevant in the education industry as educators and students use it to exchange ideas during the lockdown irrespective of their respective geographical locations. Other online platforms used for teaching and learning during the Covid19 lockdown include Google Classroom, Kahoot, Khan Academy, Desire2learn, Edmodo, Google Sites, Schoology, YouTube/Twitter/Facebook live, Skype, Webex, ClassDojo, Microsoft Teams, Moodle, among others. All of these online apps/platforms work with the internet in order to serve their respective intended purposes, and learning with online/internet apps is referred to as Online Learning.

Online Learning, simply put, is the type of learning that takes place remotely or virtually with the use of the internet. According to Dhull and Sakshi (2017), online learning encompasses a range of technologies such as the worldwide web, email, chat, news groups and texts, audio and video conferencing delivered over computer networks to impart education. Dhull and Sakshi opined that the advantages of the online learning are that it helps learners to learn at their own pace, and according to their own convenience. Teachers and students share ideas either in real-time mode (synchronous) or non-real-time mode (asynchronous). Whichever way instruction is delivered, what matters most is the ability of learners to follow the lesson activities and be able to respond at a specified period of time. Online learning is believed to improve students' level of academic achievement since they have the opportunity to access the materials from the comfort of their homes as well as interact with the lesson contents as if they are in the face-to-face teaching and learning environment. Online courses have been found to be conducive to students who favor self-regulated learning (You & Kang, 2014). In a study conducted by Kirtman, a student responded to online coursework by stating, "It is more self-guided so I can spend more time on the concepts that I need help with and less on concepts that I can pick up quickly" (Kirtman, 2009, p. 110). Based on the usefulness of online learning, Learning Management Systems (LMS) (such as Blackboard, Moodle, WebCT, Schoology, Google Classroom, Canvas by Intructure, D2L Brightspace, Absorb LMS, LearnDash, CertCentral, Edmodo LMS, etc.) were found most apt in addressing the issue of low access to lesson contents during and in post Covid19 pandemic.

Learning Management System (LMS) is an online platform that is developed to assist educators in creating and presenting their lesson contents virtually as well as assess learning performance of students without physical classroom contact. According to Turnbull, Chugh, and Luck (2019),

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learning management system is a web-based software platform that provides an interactive online learning environment and automate the administration, organization, delivery, and reporting of educational content and learner outcomes. Furthermore, K12Blueprint (2014) refers to LMS as an online platform that enables the delivery of materials, resources, tools, and activities to students both in and out of the classroom environment. LMS allows teachers to offer tailored instruction that can be accessed by students anytime, anywhere without geographic constraints. Also, Barreto, Rottmann, and Rabidoux (n.d.) define Learning Management System (LMS) as a platform that assists the delivery of content online for learning purposes. Barreto et al further defined LMS technically as a web-based software used to facilitate the delivery of online, face-to-face, and blended courses, whether in an academic setting or in the world of business. Majority of the LMS are interactive by design to accommodate learning styles of diverse learners who appreciate the student-learner approach to teaching and learning. The inclusion of the interactive sequences in lesson development and delivery helps to boost creativity, participation, and learning achievement of students. Virtually all LMSs accept the inclusion of multimedia contents that are highly interactive that promotes active participation, collaboration, real-time communication, accessibility, timing, flexibility, variety, and community of learners/educators. Findings from several studies have shown that multimedia instructions with high level of interaction can lead to increased learner satisfaction, higher levels of academic achievement, higher learner engagement, and a positive attitude toward teaching and learning (Fredericksen, Pickett, Pelz, Swan and Shea, 1999; Swan, 2003; Piotrow et al. cited in Zhang, 2005; Asih, 2013;). These visible benefits of LMS led to its adoption in the design and development of BT course, which is the focus of the present study.

Building technology is defined by O'Sullivan (2013) as the knowledge of the technical processes and methods of assembling buildings. It refers to the technical processes and methods used in constructing buildings (Designing Buildings, 2021). According to Learn.org (2021), a building engineering technology program focuses on the mathematical and technical aspects of building a commercial or residential structure; and it involves the process of designing and constructing buildings and other types of structures. Building technology is a course offered in technical colleges and universities in Nigeria. The Department of Building Technology; School of Technical Education, Abia State College of Education (Technical), Arochukwu is one of the technical institutions that offer the BT course. The course exposes learners to the concept of the use of technology in building of structures such as houses, hotels, churches, schools, markets, etc. In the course, students are trained to acquire skills in elementary structural design, construction method, and construction management. The *Elementary Structural Design* addresses the following course contents: structural forces, stress and strain, shearing force and bending moment in beams; the *Construction Method* addresses the following course contents: basic principles and methods of foundations, walls and floors construction, types of stairs, roofs and ceilings construction, process of setting out a simple building; while *Construction Management* addresses the following course contents: building (construction) contract and tendering.

According to NBTE (2001), on completion of BT course, students should be able to: (i) supervise and manage efficiently the construction of buildings of all sizes from setting out to final completion; (ii) understand and interpret all kinds of project drawings - architectural, structural, services to be able to implement them on site; (iii) design and prepare working structural drawings for medium size buildings structures; (iv) prepare realistic estimates in terms of cost, materials and labour for all building works including maintenance works; (v) appreciate and determine quality

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of materials to be used for construction through appropriate tests in line with relevant codes of practice; (vi) carry out surveys of various kinds on existing buildings and prepare a schedule of dilapidation and repairs; and (vii) prepare a cost effective post-tender report for all sizes of buildings contracts for competitive building. The reason for improving on how BT is taught in schools is based on the evidence of structural failures and building collapses currently being experienced in Nigeria. Punch Newspaper (2016) listed some of the tragic building collapses in Nigeria to include the synagogue building collapse in September 2014; the Lekki building collapse in March 2016; the uncompleted building in Abuja in August 2010; the Jos school building collapse in September 2014; the Bank of Industry building collapse in March 2006; the collapse of House No. 12, Hadeja Road, Kaduna in July 11, 2013; among others. TheCable Newspaper (2021) reported that building collapse, though a common phenomenon all over the world, is more rampant and devastating in developing countries. According to CBS News (2021), building collapses occur as a result of building with the use of substandard materials, negligence and a lack of enforcement of construction standards. TheCable Newspaper (2021) reported that many of the documented cases of building collapse in Nigeria are due to the use of defective or substandard building materials, lack of requisite technical knowledge, non-adherence to building codes, standards and regulations, lack of maintenance, use of non-professionals and the high level of corruption which has ravaged every sphere of the construction industry including government and private parastatals. Therefore, this calls for a change of the current method (conventional approach) the future professionals (students) are taught BT course in a modern digital society.

It is evident that the teaching and learning BT course has not adopted modern and student-centred approaches or methods in the Abia State College of Education (Technical), Arochukwu, Nigeria. Preliminary observations by the researchers of this study revealed that the teaching and learning BT course in a conventional classroom face a lot of challenges ranging from Covid19 pandemic lockdown, limited number of periods the course is taught in a week, industrial actions embarked by teachers for non-payment of salaries, the use of chalkboards to draw skeletal view of buildings to non-use of multimedia materials to show or demonstrate real-life BT concepts such as what causes structural failure, how to identify structural failure and how buildings collapse and how to prevent it, among others. Based on these shortcomings, the present study designed, developed and implemented a moodlecloud-based platform for teaching and learning of BT course in Abia State College of Education (Technical), Arochukwu, Nigeria.

Moodle means "Modular Object-Oriented Dynamic Learning Environment". It is an online educational platform that provides custom learning environments for students (Techterms, 2018). Educators can use Moodle to create lessons, manage courses, and interact with teachers and students for free. Developed on pedagogical principles, Moodle is used for blended learning, distance education, flipped classroom and other e-learning projects in schools, universities, workplaces and other sectors (Wikipedia, 2021). Moodle allows students to access course materials, gain feedback, contact tutors, upload work, see grades and much more all by logging in to their very own online account (Online Learning College, 2015). With around 80 million students, Moodle is one of the biggest and widely-used platforms around. Moodle has an assorted tools that facilitate the design and implementation of interactive virtual classrooms. These tools include announcements, news and events, chats, survey, wikis, discussion forums, databases, activity control, etc. Educators and course creators can also add audio, video, whiteboards and enable desktop sharing and online conferencing. While Moodle is robust with many options available, it could be a bit complex to set up, run, and maintain, especially for someone not-so-

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tech-savvy (Pathak, 2021); this is the reason why MoodleCloud and other Moodle hosting platforms were released.

Moodlecloud is one of the Moodle's hosting services. It is a versions of Moodle app and the fastest way to get a Moodle site for trial or off-the-shelf applications. MoodleCloud has a range of low cost and low maintenance hosting plans including updates and backups (Pathak, 2021). The present study utilized Moodlecloud to develop an interactive learning experience for learners in the BT course. The BT course can be accessed through this link: https://buildtech.moodlecloud.com/. Each course module contains announcements, lesson contents and materials for download, web links to external sources, chats, survey, forum, quiz, wiki, videos and images, etc. that facilitate active teaching and learning process in the course. Students receive announcements on their current or scheduled lesson activities as well as news and events regarding the module under discussion including the tracking of active online users/participants. Furthermore, the participating students can be engaged in activities that will bring out their personal ability to comprehend with the learning materials. Such activities include engaging the students in survey to rate their understanding of the course/module before it is introduced and after it was taught; engaging students in real-time conversations to further discuss the module for a particular week; engaging students in collaborative wiki activities to edit and contribute to already presented or uploaded contents by other learners; creation and presentation of quiz questions to assess students' level of understanding of a module among others. Lessons can be presented to be read online or to be downloaded for offline reading depending on the learner's choice. Moodlecloud, as a user-friendly platform, allows for inclusion of multimedia elements – video, audio, text, picture, animated demonstrations, simulated presentations, hyperlinks and hypermedia, etc., which cater for students' learning styles.

Review of Related Empirical Studies

Researches have been conducted on the adoption, integration, implementation and effectiveness of ICT/software and web-based platforms in teaching and learning in schools across the globe. Nwangwu, Obichukwu, Uzuagu and Omeh (2021) conducted a study on the development of an interactive PowerPoint presentation design training package (IPPDTP) for Lecturers of Tertiary Institutions. Findings revealed that IPPDTP was functional and very effective in mastering PowerPoint presentation designs while users expressed satisfaction; males recorded a higher mean compared to their female counterparts on their level of satisfaction with the IPPDTP based on gender. Similarly, Ibezim, Onyia and Nwangwu (2020) conducted a study on Using Digital Learning Objects (DLOs) for Students' Achievement in Computer Appreciation Studies (CAS). Findings of the study showed significant increase in the scores of students taught CAS using DLOs irrespective of gender. Andreas, Müller, Linden, Klois and Künne (2014) conducted a study on the development of an e-learning platform named "Third Place of Learning" (TPL), for vocational education systems in Germany. TPL supports student's digital learning by means of interactive examples and exercises. Also, another study carried out by Nguyen, Hite, and Dang (2019) on Web-based Virtual Reality development in classroom: From learner's perspectives revealed that students exhibited technological acceptance by not only learning and implementing WebVR in a short time (one month), but were also capable of demonstrating creativity and problem-solving skills with classroom supports (i.e., preproject presentations, online discussions, exemplary projects, and TA support).

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Despite the numerous positive findings of various studies regarding the effectiveness of computer/web-based teaching and learning platforms, other studies (Milovanović, 2010; Nwangwu, 2010; Nnajiofor & Achukwu, 2011; Nwangwu, 2011; Hallyburton & Lunsford, 2013; Hemant, Rajiv & Lal, 2014; Gillett-Swan, 2017; Mathew & Iloanya, 2019) have reported challenges of using digital platforms such as LMS in teaching and learning. For example, Nwangwu (2011) enumerated the challenges of integrating Moodle into the teaching and learning process in Nigerian higher institutions to include: non-regular training of staff on technology innovation in the form of professional development, broadband and wireless connectivity issues, poor or non-provision of infrastructure and funding, frequent electricity interruption, lack of confidence and enthusiasm in exploring digital technologies on the part of the teacher, poor equipment maintenance culture, among others. According to a study by Nnajiofor and Achukwu (2011), some of the challenges in implementing e-learning in Nigerian higher institutions include among others unwillingness or reluctance in adopting new digital technologies, poor or slow awareness on the effectiveness of e-learning in education and training, bandwidth issues and connectivity, low-level of computer literacy, lack of/inadequate technically experienced lecturers, limited ICT facilities, and problem of electricity. Nwangwu (2010) identified among others teachers workload issues, time management, low funding for infrastructural acquisition/setup, poor maintenance culture, inadequate provision of electricity, as the factors that affect effective adoption and utilization of ICTs in schools.

According to Yun-Jo An (n.d.), among barriers to effective use of web 2.0 tools for instruction is the challenge of creating meaningful assignments to promote desired learning outcomes. Ill-designed assignment with no visible connection to the overall purpose of the course not only frustrates students, it decreases students' interest in using the tool, and results in little or no learning (Reynard, 2009). Yun-Jo An (n.d.) highlighted the following - uneasiness with openness, technical problems and time as among the barriers to effective adoption of web-based platforms for teaching and learning. According to Yun-Jo An, in terms of uneasiness with openness, a number of participants noted that the open nature of Web 2.0 technologies is still new to many students. These students preferred one-to-one teacher-student interaction more than public, peer-to-peer interactions. In terms of technical problems, five participants reported that students who have older computers often have technical issues when using Web 2.0 tools. It was also noted that some Web 2.0 tools are "still a little primitive," having technical glitches and might not work well with current course management systems. Several participants mentioned that universities do not provide enough technical support for faculty who are unfamiliar with Web 2.0 technologies. Regarding the issue of time, it takes time to learn and manage new technologies. Several participants reported that learning new technologies takes time away from learning subject matter content. Milovanović (2010) pointed out the complexity of work environment, lack of skilled labor, need for reduction of training cost, social and demographic changes, requirement for greater flexibility in the workplace, and rapid growth of the Internet as some of the challenges of e-learning in schools.

Based on the review of the literature, it is evident that none of the studies addressed the design and implementation of Moodlecloud-based platform (MBP) for teaching and learning BT course in Abia State College of Education (Technical), Arochukwu. Furthermore, it is not known the extent

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to which students are satisfied with such innovative technology (MBP) and the challenges likely to encounter while learning with MBP. This is the gap to be filled in this study.

Theoretical Framework

This study was anchored on the Cognitive Theory of Multimedia Learning (CTML) and Constructivist Theory. CTML was propounded by Richard E. Mayer in 1997, and was based on how people learn from words and visuals. Multimedia learning, according to Mayer, occurs when people build mental representations from words and pictures. The words can be spoken or written and the pictures can be any form of graphical imagery including illustrations, photos, animation, or video (see Fig. 1). CTML covers the following principles of multimedia learning: Multimedia (students learn better from words and pictures than from words alone), Personalization (students learn better when words are in conversational style rather than formal style), Coherence (students learn better when irrelevant words, pictures, and sounds are eliminated from the presentation), Signalling (deeper learning is attained when learners receive signals that inform them on key steps), Redundancy (students learn better from narration and animation compared to animation, narration, and text); Segmentation (learners will learn better if narrated information is divided into small segments for easy comprehension), among others.

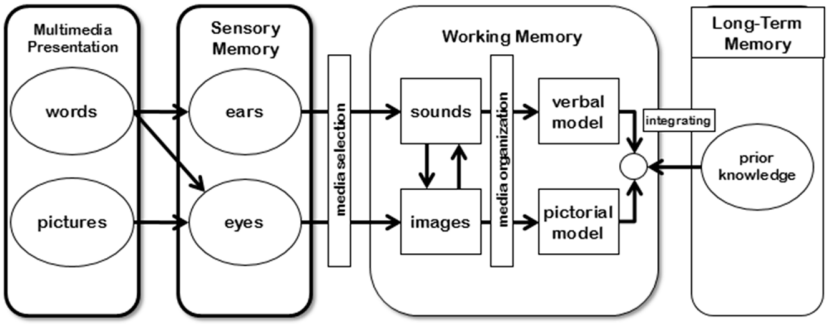

Fig. 1: CTML (The Cognitive Processes)
Source: Mayer (2005)

CTML is relevant to the present study because, MBP was designed to foster deeper learning by allowing users (students) to have control of the pace of the lesson (interactive principle); organization of contents and learning experiences into learnable modules for easy comprehension (segmentation principle); and use of audio-visual materials to engage learners in the learning activities so as to cater for both their auditory and visual processing channels (multimedia principle).

On the other hand, constructivism is a theory of learning and an approach to education that lays emphasis on the ways that people create meaning of the world through a series of individual constructs. The constructivists believed that knowledge is constructed by the learner and that the learner develops his/her own understanding through experience. The principles of constructivist theory of learning include: (i) knowledge is constructed (ii) people learn to learn, as they learn (iii) learning is an active process (iv) learning is a social activity (v) learning is contextual (vi) knowledge is personal (vii) learning exists in the mind (viii) motivation is key to learning. The present study was anchored on cognitive and social constructivism. Cognitive constructivism focuses on the idea that learning should be related to the learner's stage of cognitive development.

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In this case, students learn new information by connecting it to things they already know, enabling them to make modifications in their existing intelligence to accommodate the new information (Bruner, 1966). On the other hand, social constructivism by Lev Vygotsky (1978) focuses on the collaborative nature of learning. Knowledge develops from how people interact with each other, their culture, and society at large. Learning from others helps them construct their own knowledge and reality.

With the growing popularity of online learning, instructional platforms should facilitate an interactive problem-based environment in which the student is empowered to take charge of his or her own learning. The platform has to be interesting, engaging and appealing; it must also be authentic, personally relevant, challenging to learners, and provide a physical simulation of the real-world task environment. This enables learners explore the course contents and perform activities that are engaging and productive. This theory is relevant to this study in a number of ways. Firstly, the students are at liberty to explore the course as soon as the web link is sent to them. Secondly, the students engage in collaborative activities such as chats and forum discussions which are similar to the normal WhatsApp, Instagram and Facebook chats they have experienced. MBP was designed in such a way to allow students think critically and interact with the BT course contents to construct their own meaning.

Purpose of the Study

Generally, the study designed and implemented a Moodlecloud-based Platform (MBP) for teaching and learning Building Technology (BT) course in Abia State College of Education (Technical), Arochukwu. Specifically, the study:

1. determined the difficulty level of contents of the BT course.
2. designed and developed MBP for the BT course.
3. ascertained students' level of satisfaction in learning BT with the developed MBP.
4. determined the challenges faced by students in using Moodlecloud-based platform (MBP) in learning BT course.

Research Questions

1. What is the difficulty level of contents of the BT course?
2. To what extent are students satisfied in using MBP to learn BT?
3. What are the challenges faced by students in the use of MBP to learn BT?

Research Methods

This study employed Research and Development (R&D) design. Luenendonk (2019) defines Research and Development as utilizing findings of a research for the production of specific products including materials, systems and methods. According to Nworgu (2006), Research and Development, when applied in the field of education, is aimed at developing and testing more efficacious educational products that could be textbook, equipment and curricular. R&D design was appropriate for this study because it aimed at using research findings to design and implement Moodlecloud-based platform (MBP) for teaching and learning BT. A mixed research approach involving the use of questionnaire and structured interview schedule, were utilized for data collection, and were analyzed and reported quantitatively and qualitatively respectively. A mixed research method, according to Creswell (2012), is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative research and methods in a single study to understand a

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research problem. Questionnaire was developed to collect quantitative data for research question one while research questions two and three utilized structured interview schedule to collect qualitative data from the respondents. A one-page interview summary sheet was used to summarize the main findings of the interview. The main advantage of a summary sheet is that it enables investigators/researchers to reduce vast amounts of information into manageable themes that can be easily examined (Kumar, 1989).

The study was carried out in Abia State College of Education (Technical), Arochukwu, Abia State, Nigeria. One of the departments in the institution is the Department of Building Technology that is situated in the School of Technical Education. The Department has 7 lecturers, 9 NCE year one students, 7 NCE year two students and 2 NCE year three students. At NCE year one and two, all the students offer BT course and then specialize at NCE year three. The instruments developed for the study are: Building Technology Needs Assessment Questionnaire (BTNAQ), Students' Satisfaction Interview Schedule (SSIS), and Students' Challenges Interview Schedule (SCIS). The BT lecturers responded to BTNAQ instrument that was used to collect data for research question one while students responded to research questions two and three through SSIS and SCIS instruments respectively. The instruments were validated by three experts: one Building Technology lecturer, one Measurement and Evaluation lecturer, and a Web developer. Cronbach Alpha method was used to estimate the internal consistency of the instrument for research question one, which yielded the coefficient of 0.81. The data collected for the study were analyzed and interpreted using mean scores and standard deviations for research question one. For the interpretation of research question one, items >= 3.50 are Very Easy; items >=2.50 and <= 3.49 are Somewhat Easy; items >= 1.50 and <= 2.49 are Somewhat Difficult; and items <= 1.49 are Very Difficult. On the other hand, research questions two and three were analyzed qualitatively.

The ADDIE (Analysis, Design, Development, Implementation and Evaluation) model guided the processes involved in the development of MBP. The study first analyzed the need for the design and implementation of MBP using BTNAQ to collect data on the difficulty level of contents of the BT course as it is currently taught in a conventional face-to-face classroom. Based on the findings of the needs analysis, MBP was designed to incorporate the difficult and abstract segments of the BT course in the following distinct units: Elementary Structural Design, Construction Methods, and Construction Management. Each unit has sub-units that incorporated multimedia elements and collaborative activities' tools to interactively present concepts for better understanding. This was done at the Design and Development stages of the ADDIE model. At the implementation stage of the ADDIE model, the developed MBP was launched (see link: https://buildtech.moodlecloud.com/) and students were granted access to learn BT for the full semester. At the end of the course exercise, the students' level of satisfaction with the MBP was determined. Similarly, the challenges encountered by the students in the course of their online study were also determined so as to reveal the areas for further improvement.

The Design and Development of MBP

The design and development of MBP at the Design and Development stages of the ADDIE model was based on the Waterfall Model of Software Development Life Cycle (SDLC) by Royce (1970). SDLC is a systematic process for building software that ensures the quality and correctness of the software built (Martin, 2021). According to Powell-Morse (2016), implementing a waterfall model within a new software project is a rather straightforward process, especially due to the step-by-step nature of the method itself. The present study adopted the Modified (Iterative) Waterfall

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model that has the feedback approach. Feedback obtained from testing the software often leads back to the design and coding phases if there are any identified errors. Modified waterfall provides a useful and flexible structure with an indication of how to handle unusual or unexpected situations (Nwangwu, 2018). The phases of the modified Waterfall Model adopted in this study are: *Phase 1:* Requirements' collection and analysis, *Phase 2:* Design, *Phase 3:* Coding, *Phase 4:* Testing, *Phase 5:* Installation/Deployment, *Phase 6:* Implementation and Maintenance.

A flowchart diagram was drawn to depict MBP logic-flow in order to understand the overview of how data are logically connected in the MBP to guide its design and development (see Fig. 2). In the flowchart, a user (student) is presented with three units (*Unit 1.* Elementary Structural Design; *Unit 2.* Construction Method; and *Unit 3.* Construction Management). The user selects a topic to learn based on his choice. Depending on the topic the user selects, the lesson activities will show by the right side of the window. Each unit contains sub-topics and lesson activities. The user is provided with an option of logging out of the MBP at any point in time and then later continues from where he/she stopped until all units have been attempted. Fig. 3 shows the MBP window that contains the three units for the BT course.

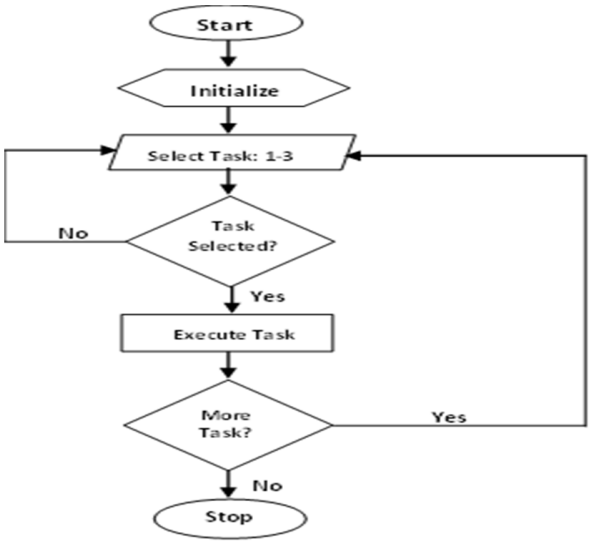

Fig. 2: MBP Flowchart Diagram;
Source: The Researchers

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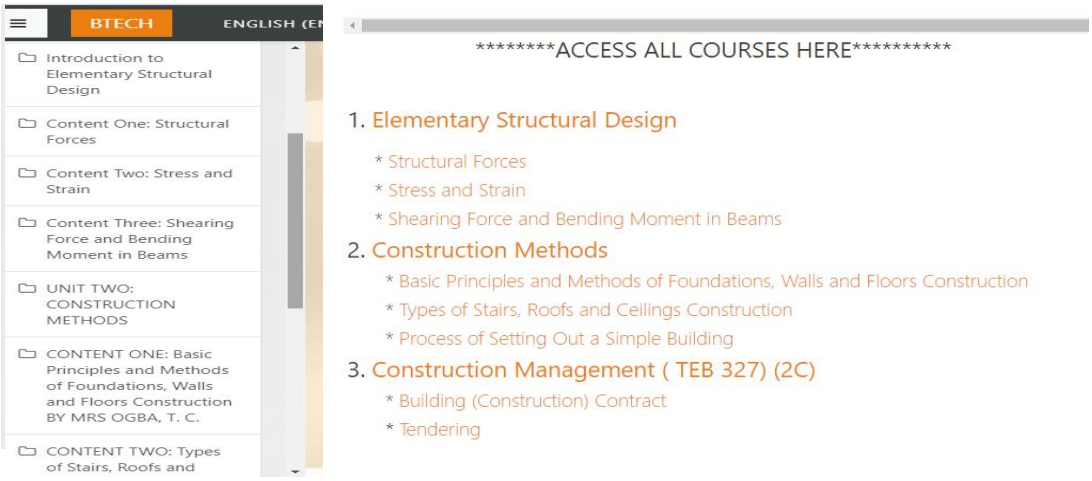

Fig. 3: MBP Units and Sub-Topic
Source: The Researchers

Field Usability Testing of MBP

The MBP was hosted in the Moodlecloud platform (https://buildtech.moodlecloud.com/). A total of 18 NCE students were registered online for the BT course. However, only the final year (NCE Year three) students that major in BT course were used for the study. They were given the course link and the login credentials to enable them access and learn with the MBP. The essence of usability testing is to expose the students to the MBP and allow them to use it at their own pace and convenience to learn BT. According to Anunobi et al. (2017), the purpose of field trial validation of a courseware is to confirm its functionality. Similarly, Guru99 (2020) expressed that one of the benefits of software testing is that it reveals customer satisfaction to ensure the best user experience.

Presentation and Analysis of Data

This section presents the results of the data analysis, findings and discussion of findings. The presentation was organized according to the research questions formulated to guide the study.

Research Question 1

What is the difficulty level of contents of the BT course?

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Table 1: Mean Ratings and Standard Deviation of Respondents on the Difficulty Level of Contents of the Building Technology Course

S/N	BUILDING TECHNOLOGY ITEMS	$\bar{x}$	SD	Remark
	Elementary Structural Design (TED 224)			
A.	**Structural Forces**			
1	Explaining structural forces	1.48	0.87	VD
2	Describing the types of forces	2.15	0.43	SD
3	Conducting a successful experiment to investigate how tensile and compressive forces are created by bending	1.25	0.91	VD
4	Explaining how shear force is created in a structure	1.49	0.83	VD
B.	**Stress and Strain**			
5	Explaining the concepts: stress and strain	2.00	0.71	SD
6	Describing the types of stress and strain in a structure under the influence of loads	1.49	0.67	VD
7	Solving simple problems on stress and strain	1.50	0.87	VD
C.	**Shearing Force and Bending Moment in Beams**			
8	Defining a beam, shearing force and bending moment in a beam	1.25	0.43	VD
9	Stating the strength requirements of a beam	2.75	1.09	SD
10	Solving problems relating to shear force and bending moments	1.47	0.82	VD
	Construction Methods 1 (TED 214)			
D.	**Basic Principles and Methods of Foundations, Walls and Floors Construction**			
11	Describing the following concepts: (i) foundations (ii) walls (iii) floors	1.51	0.59	SD
12	Stating at least three types of (i) foundations (ii) walls (iii) floors	1.75	0.83	SD
13	Explaining the basic principles and methods of construction of any type of (i) foundations (ii) walls (iii) floors	2.25	0.83	SD
E.	**Types of stairs, roofs and ceilings Construction**			
14	Describing the following concepts: (i) stairs (ii) roofs (iii)ceilings	1.75	0,90	SD
15	Stating at least three types of (i) stairs construction (ii) roofs construction (iii) ceilings construction	1.33	0.58	VD
16	Sketching the different types of stair construction	3.18	1.00	SE
F.	**Process of Setting Out a Simple Building**			
17	Defining the term" Setting Out" and stating its' purpose in Building Construction	1.99	0.28	SD
18	Stating three preliminary site works in Building Construction	1.44	0.65	VD
19	Describing the procedure involved in setting out a simple building	1.20	0.98	VD
	Construction Management (TED 327)			
G.	**Building (Construction) Contracts**			
20	Explain building contracts	2.03	0.51	SD
21	Describe the types of building contract	1.20	1.00	VD
H.	**Tendering**			
22	Differentiating between a Tender and Tendering	1.54	0.58	SD
23	Discussing the methods of tendering	1.65	0.84	SD

*Key: $\bar{x}$ = Mean; SD = Standard Deviation; SE = Somewhat Easy; SD = Somewhat Difficult; VD = Very Difficult

The results in Table 1 reveal that 11 items (1, 3, 4, 6, 7, 8, 10, 15, 18, 19, 21) had mean scores ranging from 1.20 to 1.49 indicating that the respondents agreed that the items are very difficult. On the other hand, the respondents agreed that the rest of the items (2, 5, 9, 11, 12, 13, 14, 17, 20, 22 and 23) except item 16 ($\bar{x}$ = 3.18: SE), had mean scores ranging from 1.50 to 2.75 indicating that the items were rated somewhat difficult by the respondents. The standard deviation values for the items ranged from 0.28 to 1.09 which showed that the responses of the respondents were not far from their mean scores.

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Research Question 2

To what extent are students satisfied in using MBP to learn BT?

Structured interview technique was used to obtain information from the third-year students that major in BT course on their level of satisfaction in using MBP to learn BT. The students expressed that,

> the developed MBP enabled them to view and conceptualize the real-life structural failures that led to building collapses both within and outside Nigeria. The students also mentioned the following as the advantages of learning BT with the MBP: the Chat section for real-time communication; the availability of downloadable files/documents for offline use; the YouTube video links showing clips of collapsed building, their causes and how to avert such disasters; the Wikis that enabled them edit documents collaboratively; the Survey that was used to rate their level of understanding of the course both before the lesson and after lesson; the Quiz that provided immediate feedback on their performance in the course; Forum for collaborative activities and learning from each other (peer discussions); the other external sources (websites) for further readings; the Announcements and News sections that inform them on learning activities; among others.

According to one of the students,

> the YouTube video links served as highly educative source to support my understanding of what happens before buildings collapse. I also understand through the clips that building professionals should not compromise by using substandard materials in building construction. I now know what are the causes of structural failures and how they can be prevented. Students of BT will benefit greatly from learning with this MBP. I pray that the platform be sustained and regularly updated to encourage more students to major in the BT discipline.

The student also stated thus:

> the support I and my classmate received from the course lecturer on the platform especially during the Covid19, was amazing. We freely expressed our minds and made useful contributions without being scolded unlike during the face-to-face classroom experience we had in our first and second years when the course was being offered by all students in the face-to-face classroom.

The other student expressed that,

> My participation in this online course provided me with a lot of benefits. The MBP responds to my actions with high level of precision. It provides immediate feedback to my actions by directing my learning flow based on the structure of the entire course contents. The most enjoyable aspect of my learning experience

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> was the educative video clips I watched as well as my active engagement with the lesson activities while learning with MBP under my teacher's guidance and supervision. Each of the course modules contains objectives that helped me to know what I will learn at the end of each topic. In fact, I enjoyed using the MBP because it is user-friendly and not complex or complicated. I receive announcement in my email and respond to my teacher's directives. I will be willing to recommend MBP for use by educators and students in learning BT at all levels of education in Nigeria.

Research Question 3

What are the challenges faced by students in the use of MBP to learn BT?

Structured interview technique was also used to obtain information from the students of BT on the challenges of using MBP to learn BT. The students pointed out that initially, they found it difficult to understand the platform since that was the first time they were exposed to such innovative teaching and learning approach. The students said,

> it takes time to learn and manage new technologies especially if this is the first time one is exposed to such new platform. Initially, we found it difficult to understand the MBP interface and this took away part of the useful time we should have invested in the actual learning.

Furthermore, the students expressed that the workload from other courses interfered somehow with their active participation in the course which made them to put extra efforts in order to cope with the challenge. The students also pointed out that in as much as MBP was fantastic, it requires an internet-enabled device, data subscription and quality internet connection for faster browsing. These are costly and the school/department did not provide funding for the purchase of digital devices and data subscription.

On the issue of technical support, one of the students said

> in some occasions, I experienced poor connectivity to the internet especially when I am free to do my assignments or participate in the rea-time discussion with my lecturer. I felt so frustrated that I had to subscribe to more than one Internet Service Providers (ISPs) so as to switch over when one network fails. The school-based internet is always slow and frustrating so I had to spend my pocket money to buy data for my device.

The other student said,

> the use of technology in teaching and learning in my school can only make sense to students if the school management will fund its use as well as motivate students and lecturers to adopt digital technologies in the classroom through the provision of incentives and other interventions. Both students and lecturers should be trained regularly on the various digital technology platforms used for teaching and learning. In my own opinion, provision of technical support

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services by the school will go a long way in aligning and keying into eLearning best practices in the digital era especially during the pandemic era such as the Covid19 that is currently ravaging the world thereby forcing education to be delivered through online means.

Discussion of Findings

Research question one determined the difficulty level of contents of the BT course. The results in Table 1 revealed that the BT course was generally difficult. This could be the reason why few students register it in their NCE final year (year-three) as their major discipline. According to BCIT (2020), Architectural and Building Technology (ABT) is a comprehensive program with a focus on applied learning; and it combines sound theoretical knowledge with practical skills and technical training to provide job-ready competencies for immediate application upon entering the workforce. Therefore, in order to achieve applied learning, modern and effective methodologies will need to be adopted in information delivery of the course. This is an indication that implementing digital technology and new methodologies in the BT course will go a long way in simplifying the course contents thereby attracting more students to the course.

Research question two identified the extent students are satisfied with the use of MBP to learn BT. The findings of the structured interview conducted revealed that the students are satisfied with the MBP as it enabled them watch video clips on structural failures and building collapses both within and outside Nigeria. Furthermore, findings revealed that MBP contains features (such as chats, wikis, survey, forum, quiz, announcements and news, etc.) that boost active learning. This is in line with Turnbull, Chugh, and Luck (2019), who stated that LMS provides an interactive online learning environment and automate the administration, organization, delivery, and reporting of educational content and learner outcomes. According to Online Learning College (2015), Moodle platform allows students to access course materials, gain feedback, contact tutors, upload work, see grades and much more all by logging in to their very own online account. Furthermore, it was revealed that the video clips (YouTube) helped the students to clearly understand that building professionals should not compromise by using substandard materials in building construction. This corroborates with TheCable Newspaper (2021) that reported that many of the documented cases of building collapse in Nigeria are due to the use of defective or substandard building materials, lack of requisite technical knowledge, non-adherence to building codes, standards and regulations, lack of maintenance, use of non-professionals and the high level of corruption which has ravaged every sphere of the construction industry including government and private parastatals.

The findings on research question three showed that the challenges faced by students in the use of MBP to learn BT include initial stress in understanding MBP interface having being their first exposure on such innovative online platform; workload from other courses somehow interfered with their active participation in the online course; slow internet connectivity often do occur which affected their effective use of MBP to play video resources and participate in interactive sessions. Other challenges expressed by the students include cost of data subscription, lack/inadequate technical support, non-provision of incentives to motivate both lecturers and students to adopt online learning, etc. These challenges are in agreement with Nwangwu (2011), Nwangwu (2010), Nnajiofor and Achukwu (2011) who reported non-regular training of staff on technology innovation, broadband and wireless connectivity issues, poor or non-provision of infrastructure and funding, frequent electricity interruption, poor equipment maintenance culture, unwillingness or reluctance in adopting new digital technologies, limited ICT facilities, and problem of

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electricity, etc., as challenges affecting effective utilization of ICT in teaching and learning in Nigerian schools.

Conclusion

Building technology is one of the courses offered in Nigerian Technical Colleges and Universities. The course was introduced to equip learners with the technical skills required to professionally undertake building construction jobs on graduation so as to reduce or eliminate the cases of building collapse that are currently ravaging the country. Therefore, this study designed and implemented a Moodlecloud-based Platform (MBP) for teaching and learning BT in Abia State College of Education (Technical), Arochukwu. The findings of the study revealed that generally, the contents of the BT course are difficult; students' level of satisfaction with MBP was found to be high based on their expressions during the structured interview exercise. It was further revealed that cost of data subscription, workload from other courses, are among the challenges encountered in the online course. Therefore, the study recommended among others that school management and ministry of education should financially support the hosting of courses in Moodlecloud-based platform since it has been proven to increase students' interest in teaching and learning especially in the BT course, in all Technical Colleges in Nigeria.

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