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DEVELOPMENT AND EVALUATION OF WEB-BASED AUTHORING SYSTEMS FOR LEARNING SELECTED EDUCATIONAL TECHNOLOGY CONCEPTS IN UNIVERSITY OF ILORIN, NIGERIA

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Abstract

Web-based authoring systems (WBAS) present a revolutionary approach to remote instruction, enabling new teaching experiences beyond the capabilities of traditional classrooms. Despite its potential, WBAS usage remains limited in Nigerian universities. This study aimed to develop and evaluate a WBAS for learning educational technology concepts at the University of Ilorin. The study adopted design and development research model; this study utilized a significant learning-integrated course design. The target population comprised 1,200 Educational Technology undergraduates, from which a purposive sample of 50 students (25 males and 25 females) was selected based on their access to high-quality ICT devices. Eight instruments were employed: WBAS, Subject Matter Content Manual (SMCM), Subject Content Validation Questionnaire (SCVQ), Educational Technology Experts' Questionnaire (ETEQ), Computer Science Experts' Questionnaire (CSCEQ), Students Interview Protocol (SIP), and two Students Response Questionnaires (SRQ1 and SRQ2). Reliability testing showed coefficients of 0.80 for WBAS and 0.82 and 0.76 for SRQ1 and SRQ2, respectively using Cronbach Alpha. Data analysis included mean, percentage, and t-test at a 0.05 significance level. The findings of the study indicated that the WBAS was effectively developed using Dee Fink's Significant Learning-Integrated Course Design Model, with experts rating the system positively (mean scores > 2.50). Additionally, the WBAS proved effective for learning communication concepts (mean score = 3.76), with students showing positive attitudes toward its use. No significant gender interaction effect was observed. The study concluded that the developed WBAS enhances students' learning and performance in communication concepts. The study suggests that effective use of WBAS can significantly improve teaching and learning processes in educational technology and other courses in Nigerian universities. It is recommended that WBAS be implemented to teach various concepts across different disciplines.

Keywords: *Web-based authoring systems, Remote instruction, Educational technology Learning outcomes and University of Ilorin*

INTRODUCTION

The 21st century has seen a paradigm shift in education, driven by rapid technological advancements. These innovations have transformed learning from a teacher-centric model to a more personalized and adaptive approach. The influx of personalized information and tools due to technological innovations has impacted students at an unprecedented rate. Classroom learning is no longer confined to the information provided by the teacher; it is constantly being supplemented or challenged by numerous other sources available through technology. Consequently, the role of educators is evolving, with a greater emphasis

on integrating Information and Communication Technology (ICT) tools to enhance the teaching and learning process (Charlott et al., 2021; Salim et al., 2024).

Globally, educational systems are increasingly incorporating ICT tools to improve the quality of education (Cooper et al., 2020; Salim et al., 2024). Macedo et al., (2024) emphasizes that the use of ICT in education leads to positive outcomes such as increased motivation, active learning, efficient resource utilization, and better access to information. Similarly, Maryuningsih et al. (2020) and Wang et al. (2017) argue that technology enhances learner motivation, connects students to diverse information sources, supports collaborative learning, and allows teachers more time for classroom facilitation. Integrating ICT into education not only enriches the learning process but also prepares students for future professional activities (Vastimir & Dalibor, 2019).

The integration of ICT in education extends beyond traditional face-to-face lectures, with tools like online discussion forums emerging as effective means of engaging students outside the classroom (Adnan & Anwar, 2021; Balaji et al., 2015; Moorhouse, 2020). ICT has become a foundational element in modern education, and proficiency in ICT skills is now recommended in most educational sectors for efficient classroom instruction (Bozkurt & Sharma, 2020; Hadar et al., 2020; Rampersad, 2011). E-learning, facilitated through web-based platforms, has emerged as a pivotal method to deliver educational content effectively. Defined as learning supported by ICT via the Internet, intranets, or extranets, e-learning aims to enhance educational quality (Davidson et al., 2018; Morze et al., 2021). It encompasses various formats, from web-supplemented courses to fully online programs (OECD, 2012). Despite its potential, e-learning integration in Nigerian universities, including the University of Ilorin, remains limited. This challenge is not unique to Nigeria; many African universities are still in the early stages of e-learning adoption (Macharia & Nyakwende, 2010). There is an urgent need for universities to understand and implement effective e-learning systems to improve educational delivery and student engagement (Yang et al., 2021).

Limited research in Nigeria has explored students' use of e-learning (Afari-Kumah et al., 2010; Quasims et al., 2020). E-learning provides a novel approach to delivering classroom instruction to remote audiences using the web (Khan, 2013; Mishra et al., 2021). Ascough (2012) suggests that online instruction offers a different learning experience compared to traditional classrooms due to variations in learner interaction, communication methods, and the social dynamics of the learning environment. This approach reduces discrimination and prejudice, allowing learners to access information individually and at their own pace.

The web's use as an educational tool provides teachers with a wide range of new and exciting teaching experiences not possible in traditional classrooms (Nam et al., 2017). These experiences include accessing information anytime and anywhere, online presentation opportunities, interactive task-based activities, effective information dissemination, and long-distance education. Web-Based Learning Resources (WBLRs) are powerful tools for enhancing learning experiences and outcomes.

Authoring tools, as defined by Ning et al. (2019), are software applications used to develop e-learning products. These tools facilitate the creation of interactive courses or learning objects by integrating and relating objects such as text, pictures, animations, and videos. Users with basic computer literacy can utilize these educational authoring tools, which feature graphical interfaces for designing content and interfaces. Advanced learning objects can be developed using programming or scripting languages. These tools support various output formats and pedagogical properties, making them essential for professional, accessible, interactive, and engaging e-learning systems.

Authoring tools enable the creation and population of learning courses with instructional materials accessible on various modern devices, both mobile and desktop. An effective e-learning solution should integrate multimedia content, audio, video, images, text documents, and interactive components. The inclusion of video converters and the latest HTML versions, like HTML5, ensures compatibility and efficiency (Nor & Albert, 2018).

Developed authoring materials or learning objects can be published on the web, run on standalone computers, or be embedded into a learning management system (LMS). Authoring tools fall into categories such as single-purpose authoring tools, activity tools, course development and presentation tools, general presentation tools, and test and evaluation tools. These tools are used in both online and traditional learning environments, offering ease of saving, editing, reusing, and sharing compared to printed materials (Khademi et al., 2011). Subject matter experts, teachers, and curriculum developers use these tools to develop instructional content, making the teaching process easier and more engaging, supporting communication, and sharing information outside of school (Gaffney, 2004).

The design, development, and evaluation of instructional packages benefit from models that guide the creation of authoring systems to meet learners' needs. Evaluation models relevant to educational technology include Tyler's Goal-Based Model, Scriven's Goal-Free Evaluation Model, Stufflebeam's CIPP Model, Kirkpatrick's Evaluation Model, Bates' ACTIONS Model, and the ETIMI Model (Guskey, 2000; Alaa, 2009). This study adapted Dee Fink's Significant Learning-Integrated Course Design Model (2003) and the Principles of Online Design by Florida Gulf Coast University (2006) as guiding principles. The Kirkpatrick Model of Evaluation (2006) was used, focusing on reaction and learning levels due to the study's time constraints.

Kirkpatrick's reaction level evaluates how learners respond to training, measuring satisfaction and attitudes (Arthur et al., 2002a; Kirkpatrick, 1998). Learning measures changes in knowledge, skills, and motivations resulting from training (Arthur et al., 2002b; Schumann, 2001). This model is straightforward and simplifies complex evaluation processes, making it suitable for program improvement, accreditation, and determining overall program impact.

Attitudes significantly influence behavior, with a strong connection between positive attitudes towards ICT and successful integration into the curriculum (Burnet, 2003). Studies have shown that university students in developing countries generally have positive attitudes towards e-learning, which positively impacts motivation and self-esteem (El-Gamal & Abd El Aziz, 2011; Nassoura, 2012). Positive attitudes towards computer-based instruction correlate with better performance, highlighting the importance of attitudes in technology-based education (Ibronke et al., 2017).

In summary, developing and evaluating web-based authoring systems for teaching educational technology concepts at the University of Ilorin is essential for enhancing student engagement and learning outcomes. By leveraging ICT tools and effective authoring practices, universities can bridge educational gaps and prepare students for the modern digital age.

Statements of the Problems

The influence of Information and Communication Technology (ICT) has significantly altered conventional teaching and learning paradigms. The emergence of web-based authoring systems and e-learning technologies has made it possible to extend classrooms to the Internet and provide one-on-one education. These systems integrate modules for content delivery, organization, student testing, and performance assessment in colleges and universities. However, the Educational Technology programs at the University of Ilorin face significant challenges despite the growing enrollment of students each year. The increasing number of students has exacerbated issues related to

inadequate learning facilities and frequent disruptions of traditional classroom settings. This situation has created a learning environment that is not conducive to effective education. The lecture delivery methods are not tailored to accommodate the diverse learning paces of students in a technology-based classroom. Additionally, students who miss lectures often find it difficult to catch up on missed content, as they miss the nuanced explanations and instructional techniques employed by experienced lecturers.

There is a clear need for an e-learning solution that allows students to learn and access instructional information effectively, regardless of classroom time constraints, location, learning environment, or the large number of students. This study aims to develop and evaluate a web-based authoring system for learning selected educational technology concepts at the University of Ilorin, Nigeria. By doing so, it seeks to address the challenges posed by inadequate facilities and the disruptions of traditional classroom settings, providing a more flexible and effective learning solution for students.

Purpose of the Study

The main purpose of this study was to developed and evaluate web-based authoring system for learning selected Educational Technology Concepts in university of Ilorin, Nigeria. Specifically, this study:

1. developed Web-based authoring system for learning communication concepts in educational technology;
2. evaluated the developed Web-based authoring system for learning communication concepts;
3. Investigated the effectiveness of the use of the Web-based authoring system on undergraduate for learning communication concept;
4. examined undergraduates' attitude to the developed Web-based authoring system for learning communication concepts; and
5. evaluated the interaction effect of gender on the use of Web-based authoring system on undergraduate.

Hypotheses

The following research hypotheses were tested in this study at 0.05 level of significance.

H_{01}: There is no significant difference between the performances of students before and after they have been exposed to Web-based authoring system.

H_{02}: There is no significant difference between the performance of male and female Students taught using Web-based authoring system.

Methodology

This study utilized a design and development research methodology (Richey, Klein & Nelson, 2004), which encompasses the design, development, validation, and application of models. Specifically, a pre-experimental single sample design was employed. The focus was on the development and evaluation of a Web-based authoring system, integrating educational technology concepts as instructional content. The independent variable in this study was the Web-based authoring system, while the dependent variable was student achievement.

The research adapted the Significant Learning-Integrated Course Design Model by Dee Fink (2003) to accommodate diverse learning styles, needs, and participation levels, facilitating individualized activities. Additionally, principles of online design guided the creation of the Web-based authoring system. To evaluate its effectiveness, Kirkpatrick's Four Level Evaluation Model (2006) was applied, specifically the first two levels. Students were given a pre-test before using the system and a post-test afterward to assess the impact on their learning outcomes.

The study population included educational technology experts, computer science experts, and educational technology undergraduates in Nigeria, with a target population at the University of Ilorin. The sample

comprised two categories: experts for validating the authoring tools and undergraduates for determining their effectiveness. The expert sample consisted of five educational technology experts and five computer science experts, randomly selected from their respective departments at the University of Ilorin. The selection criteria for educational technology experts included involvement in teaching various educational technology concepts and designing instructional models. Computer science experts were chosen based on their experience with ICT-based instructional strategies and web design for instruction.

Additionally, 50 undergraduate students from the Department of Educational Technology at the University of Ilorin were purposively selected based on specific criteria: the university's long-standing educational technology program, the provision of internet-enabled tablets to students, and the possession of functional tablets, Android or iPhones, and Gmail accounts.

Eight instruments were used for the study: WBAS, Subject Matter Content Manual (SMCM), Subject Content Validation Questionnaire (SCVQ), Educational Technology Experts' Questionnaire (ETEQ), Computer Science Experts Questionnaire (CSCEQ), Students interview Protocol (SIP) Students Response Questionnaire (SRQ1) and Students Response Questionnaire 2 (SRQ2). The eight instruments (6 standardized and 2 researchers-designed) were validated but only WBAS and student's response questionnaire were tested for reliability; the WBAS was tested for reliability at 0.80 coefficient using Pearson Product moment correlation and Students Response Questionnaires were tested for reliability and the results yielded 0.82 coefficient for SRQ1 and 0.76 coefficient for SRQ2 respectively using Guttman Split-half correlation

Results

Demographic Characteristics of the Participants

The distribution of students on gender was analyzed. The students' gender was described using percentage as shown in table 2.

Table 2: Distribution of Participants Based on Gender

Gender	Frequency	Percentage (%)
Male	25	50.0
Female	25	50.0
Total	50	100.0

Results in table 2 reveal that 25 (50.0%) were male participants while 25 (50.0%) were female. This implies that equal number of male and female participated in this study.

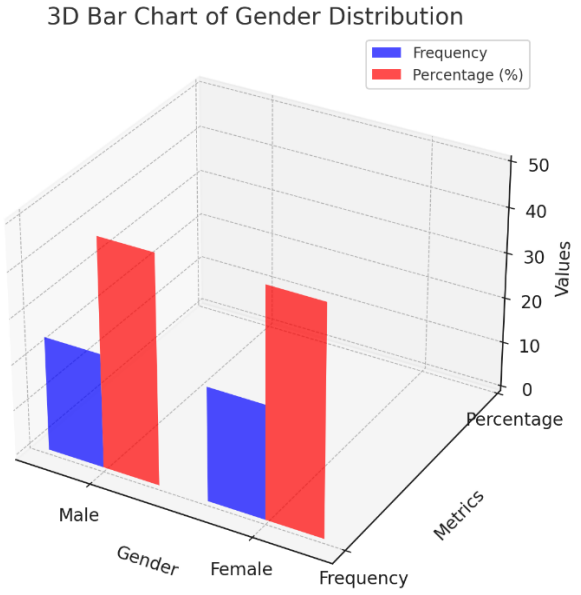

Figure 1: Demographic information of the participant by Gender

Analysis of Research Questions

Research Question One: ***What are the processes involved in the development of Authoring system on communication concepts in Educational Technology?***

WBAS was designed and developed based on the Significant Learning-Integrated course Design Model that was developed by Dee Fink (2003). The model is made up of three phases with twelve steps. The phases are: Initial Design Phase, Intermediate Design Phase and Final Design Phase. The Principles of Online Design developed by Florida Gulf Coast University (2006) was used as guiding

principles in the development of the package with Kirkpatrick (2007) levels 1 and 2 out of four levels of evaluation was also used to evaluate the package. The researcher worked hand in hand with the computer experts, software developers, and educational technologists to design and develop the WBAS. The procedure for development and evaluation was as follows:

1.Needs Assessment: This provided the data to document the need for a new approach or another paradigm shift in learning: WBAS was incorporated as new strategy into teaching and learning process.

2. Target Audience: 200 level students of the University of Ilorin were the target audience. The course was offered by all students studying Educational Technology at undergraduate level. 3. 3. Course Contents: The content chosen was one of the topics in Educational Technology in line with communication concept.

4. Instructional Recourses: The following instructional resources were used: Tablet phones, Computers, Projectors, Relevant Books on communication and Journals in Educational Technology were used as instructional resources in the study.

5. Establish what must be learnt or tasks. The tasks are mainly for instruction which will help specify the requirements for the project.

The researcher considered the following in the production of the Web-based authoring system instructional package.

Design stage

1. The documentation of the instructional course manual, visual and technical design strategy was documented (as shown in appendix c).
2. Identification of instructional objectives: These objectives were made known to the students, and at the end of each unit, tasks were provided for students (as shown in appendix c).
3. The following instructional strategies that enhanced the attainment of the intended objectives in the domains (cognitive, affective, and psychomotor) were applied (as shown in appendix c).
4. Determination of the sequence and structure for media requirements based on the hardware and software requirements, as well as for the illustration and animation that would be most effective in the attainment of stated objectives.

The development stages

The development of the Web-based authoring systems (WBAS) was done by drafting the Subject Matter Content Manual (SMCM) (Appendix 1). This was transformed into a more manageable form (units 1-6). Thereafter, copies of the SMCM were given to the researcher's supervisor, the internal external supervisor, and two experienced educational technology lecturers who are presently course lecturers in the Department of Educational Technology at the University of Ilorin for the subject content validation.

The content of the SMCM was coded for programming instruction by computer experts, instructional designers, web developers using MacroMedia Flash (development environment) macromedia time line and frames. The platform for the development of the WBAS was the HTML: CorelDraw and Microsoft word were used for texts and graphics, macromedia fireworks were used for texts, graphics and buttons, while MacroMedia Flash was used for animations. The WBAS that was developed provided instructions in form of texts, animations and illustrations. The researcher gave directives on how the content of the SMCM should be sequentially arranged and the illustration that were included in the package. The professional opinions and suggestions of the web developer experts bordering on the functionality, language, interface and navigation that could make the package adequate for instruction was adhered to.

Research Question Two: ***How do experts (Educational Technology and Computer science experts) evaluated the developed authoring system on communication concepts?***

The WBAS was given to five educational technology experts to examine and ascertain if the design and development of the package conformed to the acceptable standards in educational technology. They gave necessary comments and suggestions as well as response to the statements in the questionnaire. One of the experts suggested that the introduction to the lesson should make students to be more expectant, and that the colours on the frame should be changed. The experts also suggested that it should not be solely textual; it must be interactive and contain other visual elements; pictures, images and if possible, video.

The respondents suggested that the package was interactive and content-enabled, instant response from instructor, easy navigation and files should not be too heavy. The fourth experts advised that the colours should be reduced. The observations and suggestions made by the experts on the package were used by the researcher to revise the package appropriately. The result of the rating of the subject matter content of the WBAS using the SCVQ-Appendix 2 is presented on table 3

Table 3: Results of the Subject Content Experts Validation of WBAS

S/No	Items	SA	A	D	SD	Weighted X
1	The content of the course manual you been given to go through conforms to educational technology standards.	3	1	0	0	3.75
2	The sub-topics have been sequentially and coherently arranged.	4	0	0	0	4.00
3	The language used in the course manual is simple and easy for both teachers and students.	2	2	0	0	3.50
4	The content is sufficient to achieve the stated objectives for the selected topics in communication.	2	2	0	0	3.50
5	The assignments are relevant to the topics treated.	4	0	0	0	4.00
6	The diagrams in the manual are clear enough.	1	3	0	0	3.25
7	The evaluation questions for each lesson are relevant for the attainment of the lesson objectives.	3	1	0	0	3.75
8	The student's self-evaluation questions are relevant to the students understanding of the course content.	4	0	0	0	4.00

The result on table 3 shows the response of the subject content experts' validation of the WBAS. From table 4 the least weighted mean score was 3.25 (strongly agree and agree), while the highest weighted mean score was 4.00 (strongly agree). This implies that the subject experts agreed to most of the statements in the questionnaire. This is an indication that the subject content of the WBAS was adequate and sequentially and coherently organized.

The package was then revalidated and the experts' emphasized that there was a lot of improvements from the previous package and it could be utilized for the target respondents. Thus, the researcher selected two educational technology experts to responds to the Educational Technology Experts Validation Questionnaire (ETEVQ Appendix 4) to enable the researcher compare the ratings of the experts. Most of the experts' ratings were on the strongly agreed which implies that the experts agreed to most of statements in the questionnaire. This is an indication that the content of the WBAS was adequate and sequentially and coherently organized.

Table 4: Results of Educational Technology Experts ratings of the WBAS

No.		SA	A	D	SD	U	Weighted x scores
1.	The content is structured in a clear and understandable manner.	4	0	0	0	0	4.00
2.	The structure allows learners to move around freely in different units.	4	0	0	0	0	4.00
3.	The structure of the package permits learners to advance, review, see examples, repeat the unit, or escape to explore another unit.	4	0	0	0	0	4.00
4.	The package facilitates learning by doing	2	2	0	0	0	3.50
5.	The package allows learners to work on their own pace.	2	2	0	0	0	3.50
6.	Interactivity.	2	2	0	0	0	3.50
7.	The package provides opportunities for interaction at least every three or four screens/frames.	2	2	0	0	0	3.50
8.	The package allows learners to discover information through active exploration.	3	1	0	0	0	3.75
9.	Help key to get procedural information.	2	2	0	0	0	3.50
10.	Answer key for answering a question.	4	0	0	0	0	4.00
11.	Menu key for returning to the main page.	3	1	0	0	0	3.75
12	Exit key for exiting the programme.	3	1	0	0	0	3.75
13	Key for moving forward and backward.	3	1	0	0	0	3.75
14	Key for accessing the next lesson in a sequence.	3	1	0	0	0	3.75
15	Key for accessing new assignment or inbox.	4	0	0	0	0	4.00
16.	Screens are designed in a clear and understandable manner.	4	0	0	0	0	4.00
17.	The presentation of information can captivate the attention of students.	4	0	0	0	0	4.00
18.	The presentation of information can stimulate recall.	4	0	0	0	0	4.00
19.	The design does not overload student's memory.	3	1	0	0	0	3.75
21.	The use of text follows the principles of readability.	3	1	0	0	0	3.75
22.	The number of colours in each screen is not more than six.	3	1	0	0	0	3.75
23.	The quality of the text, images, and graphics is good.	4	0	0	0	0	4.00
24.	A high contrast between graphics and background is retained.	2	2	0	0	0	3.50

25.	The content can be updated and /or modified with new knowledge that will appear soon after the development of package.	4	0	0	0	0	4.00
26.	The package can be used in different platforms.	2	2	0	0	0	3.50
27.	There is a review of the courseware's contents for use by the instructor.	4	0	0	0	0	4.00
28.	There are instruction for the installation and use of the package.	3	1	0	0	0	3.75
29.	The package provides printing capabilities.	3	1	0	0	0	3.75
	Weighted mean scores						**3.65**

The results on table 4 show the responses of educational technology. Experts from the department of Educational Technology had the frequency counts of 96 out of the overall responses of 116; Thus, the mean score of their responses was 3.65 out of 4.00. This shows that the overall assessment of the package conformed to the acceptable standards of teaching and learning of communication concepts.

Table 5: Results of the Computer Science Expert Ratings

S/No	Items	SA	A	SD	D	U	Weight X Score
1.	The structure of the package permits learner to advance, review, see example, repeat the unit, or escape to explore another unit.	4	0	0	0	0	4.00
2.	Menu key for returning to main page.	3	1	0	0	0	3.75
3.	Exit key, for exiting the programme.	4	0	0	0	0	4.00
4.	Key for accessing the previous units.	4	0	0	0	0	4.00
5.	Key for viewing assignments.	3	1	0	0	0	3.75
6.	Key for discussion.	3	1	0	0	0	4.00
7.	The package provides feedback to verify the correctness of a response.	3	1	0	0	0	3.75
8.	The package allows student to check their performance.	3	1	0	0	0	3.75
9.	Screen is designed in a clear and understanding manner.	4	0	0	0	0	4.00
10.	The number of colour in each screen is not more than six.	3	1	0	0	0	3.75
11.	The quality of the text, illustrations and graphics is good.	3	1	0	0	0	3.75
12.	A high contrast between graphics and background is retained.	2	2	0	0	0	3.50
13	The content has durability over time.	1	3	0	0	0	3.25

14	The content can be update and/ or modified with new knowledge that will appear soon after the development of package.	3	1	0	0	0	3.75
15	The package can be used in different platforms.	3	1	0	0	0	3.75
16.	There is instruction for the installation and use of the package.	1	3	0	0	0	3.25
17.	The update, modifying and adding procedures are relatively easy for the average user.	2	2	0	0	0	3.50
18.	The package provides printing capabilities.	1	3	0	0	0	3.25
19.	The content is structured in a clear and understandable manner.	3	1	0	0	0	3.75
20.	The package facilitates learning by doing.	1	3	0	0	0	3.25
21.	The package allows learner to work on their own pace.	3	1	0	0	0	3.75
22.	The package promotes collaborative learning.	3	1	0	0	0	3.75
23.	The package encourages discussion and collaboration among learners.	3	1	0	0	0	3.75
24.	The package provides opportunities for interaction at least over three or four screen frames.		1	0	0	0	3.75
	Weighted mean score						
							3.70

Four lecturers from computer science rated the effectiveness of the WBAS and suggestions were raised on how to improve on aesthetics of the package. The experts attested that the package was easy to use and user friendly. Experts from the department of computer science had the frequency counts of 80 out of the overall responses of 96. Thus, the mean score of response was 3.70 out of 4.00. This implies that the experts rated the package very high for instructional purposes.

*Research Question Three**: What is the reaction of undergraduates toward the developed web-based authoring systems?***

In order to answer this research question, respondents' responses on the instructional package enhanced undergraduate students learning. Communication process questionnaires were collated. The data collected from the study were analysed as shown in

Table 6: Reaction of Students to the Developed Web-Based Authoring System

S/No	Items	Mean
1.	I enjoy the instruction using the software for studying communication than the conventional method my teacher uses to teach me.	3.57
2.	The lessons in the package are easy to understand.	3.93
3.	To what extent did the package arouse your interest for studying communication?	3.67

4.	The illustrations in the software are very clear and relevant.	3.83
5.	The animations and illustrations made for studying with the package were satisfying.	3.73
6.	To what extent do the lesson evaluation questions enhance memory of the acquired skills and knowledge?	3.70
7.	The students' self-evaluation questions in the software served as reinforcements of positive behaviour towards learning.	3.67
8.	Was the WBAS software satisfying for self-paced learning?	3.90
9.	The colours used for the various presentation are quite appealing.	3.83
10.	Would you prefer the use of this instructional software next semester?	3.77
	Average mean score	3.76
	Weighted Mean Score	**37.60**

Results in table 6 indicate that 50 respondents participated in the study. Responses to items that sought information on attitude of students to the developed web-based authoring systems (WBAS) revealed that the majority of the respondents' reacted that the developed web-based authoring systems was appealing to students (3.83), facilitate learning (3.93) and encourage students' individualistic learning (3.90). Also, the mean and weighted mean scores of 3.76 and 37.60 respectively indicate that instructional package was highly effective for students; learning.

Research Question Four: ***How does the developed authoring system affect undergraduate learning of communication concepts?***

In order to answer this research question, respondents' responses on the reaction of students to the developed web-based authoring systems, questionnaire were collated. The data collected from the study were analyzed as shown in Table 7.

Table 7: Undergraduates Students' Responses to Web-based Authoring system to Enhance Learning of Communication Process

S/No	Items	Mean
1.	The topic content reading and activities are relevant to the objectives stated.	3.90
2.	It is easy to understand the lessons because information is presented from simple to complex.	3.97
3.	Levels of content and vocabulary are appropriate for intended audience.	3.50
4.	The instruction enables me to achieve the objectives stated in each unit.	3.70
5.	The web pages give e-mail address or other way to contact the lecturer.	3.60
6.	The lesson evaluation questions enhance memory of the acquired skills and knowledge.	3.57
7.	The illustrations used in the units of the instruction are very clear.	3.87
8.	The students' self-evaluation questions in the software served as reinforcements of positive behaviour towards learning.	3.70
9.	The WBAS software is adequate for self-paced learning; it enables me to accomplish tasks more quickly.	3.83
10.	The colours used for the various presentations are quite appealing.	3.83
11	I prefer the use of this instructional software next semester than the method my lecturer uses to teach.	3.90
	Average mean score	**3.76**

Results in table 7 indicate the respondents' responses to items on how effective the developed web-based authoring systems (WBAS) facilitated the undergraduates learning of communication process. Table 7 revealed that majority of the respondents agreed that developed web-based authoring systems (WBAS) enhanced undergraduates learning of communication process effectively. The items 2, 3, 4, 7 and 9 revealed that lesson in WBAS was systematically presented from simple to complex, contents and vocabulary were appropriate for the intended audience, the instruction facilitated the achievement of the stated objectives in each unit, illustrations used are very clear and was adequate for self-paced learning by individual student with the benchmark mean of 3.97, 3.50, 3.70, 3.87 and 3.83 respectively. The weighted mean score was 41.37 which correspond with average mean score of 3.76. Hence, the instructional package used enhances undergraduates' learning of communication concept.

Research Question Five: ***What is the interaction effect of gender on undergraduate students 'achievements after being exposed to authoring system?***

In order to answer this research question, responses on male and female students' achievements scores on the web-based authoring systems were collected. The data collected from the study were analysed as shown in Table 8.

Table 8: Undergraduate male and female Students' Achievements on Web-based Authoring Systems

Gender	No	Percent (%)	Standard Deviation	Mean (x)
Male	25	50.0	1.96	19.47
Female	25	50.0	2.07	20.13
Total	50	100.00		

Table 8 depicts the undergraduate male and female students' achievements on response to achievements test in communication process on Web-based authoring systems. The male and female students' standard deviation were 1.96 and 2.07 respectively; while the mean scores were 19.47 and 20.13 respectively. Considering both the male and female students' bench mark of achievements to be 2.00, the female students' achievement was above the bench mark (2.07). This implies that the female students' achievement improved after being exposed to the web-based authoring systems than their male counterparts. The study concluded that the female undergraduate students considered the Web-based authoring systems to be more effective in facilitate learning.

Hypotheses Testing

The two research hypotheses that guided this study were tested using t-test at 0.05 level of significant.

H_{O1}: ***There is no significant difference between the achievements of students before and after they have been exposed to web-based authoring systems.***

Research hypothesis one was tested based on the data that were collected, collated and analysed using t-test as shown in table 8.

Table 9: A t-test Analysis of Students Exposed to Web-based Authoring Systems

Variable	No	Mean	Std	Df	Cal.t	Sig.(2-tailed)	Decision
Pre-test	25	5.87	2.43				H_{01}
				48	34.03	0.00	Rejected
Post-test	25	20.80	3.01				

P < 0.05

Results in table 9 shows that the calculated t-value (34.03) was significant at 0.00 at alpha level. Also, the pre-test and post-test mean scores of 5.87 and 20.80 respectively established a significant difference between the achievements of students exposed to web-based authoring systems. Thus, the null hypothesis one was rejected. Therefore, there was significant difference between the achievements of students exposed to web-based authoring systems in favour of the post-test achievements of the students.

H_{O2}: ***There is no significant difference between the achievement of male and female students taught using web-based authoring systems***.

The null hypothesis two was tested on the respondents' data that were collected, collated and analyzed based on male and female Students 'achievements in using web-based authoring systems. The results are as presented in table 9.

Table 10: A t-test Analysis of Achievement of Male and Female Students Taught Using Web-based Authoring Systems

Gender	No	Mean	Std.	df	Cal.t-	Sig. (2-tailed)	Decision
Male	25	21.47	2.96				H_{02}
				48	0.81	0.57	Not Rejected
Female	25	22.13	3.07				

P>0.05

Results in table 10 shows that the calculated t-value was 0.81 with significant value of 0.57 that was not significant at 0.05 alpha levels. This implies that the null hypothesis two was not rejected: hence, there was no significant difference between the achievement of male and female students taught using web-based authoring system in favour of the female students with the mean score of 22.13 against the male students' mean score (21.47).

Discussion

The study aimed to design, develop, and evaluate a web-based authoring system (WBAS) for learning communication concepts in educational technology. The WBAS was validated and demonstrated to enhance students' achievement. This study confirms the potential of developing instructional packages and integrating technological tools to improve learning outcomes. Similar findings are reported in the literature; for instance, Yusuf et al. (2017) highlighted that mobile learning instructional content design requires simplicity in screen interface, user interactivity, and feedback mechanisms. Additionally, Oputa (2014) developed an interactive digital game on phonics for early childhood education, reporting high pupil achievement in phonics.

Expert validation of the package involved four subject content experts, two computer experts, and two educational technology experts, who rated the WBAS highly and suitable for the target users. Quantitative analysis of the subject content experts' responses to content, sequential and coherent arrangement, language, diagrams, and quiz questions indicated general agreement

with the questionnaire statements. Educational technology experts rated the package's structure, navigation, feedback, screen design, and learning evaluation as strongly agreed or agreed, confirming the instructional package's adherence to educational technology standards. Computer science experts also had a positive perception of WBAS for instruction. Overall, experts found the package highly effective, suitable, and adequate for instructional purposes. The WBAS was evaluated qualitatively and quantitatively using Kirkpatrick's (2006) evaluation model. Analysis of student response questionnaires revealed satisfaction with the package's content and context. Data analysis showed higher post-test achievement compared to pre-test results, indicating the web-based authoring system's effectiveness in learning. Most respondents affirmed that the developed WBAS facilitated undergraduate students' learning of the communication process. They also indicated that the system aroused interest, was visually appealing, and facilitated effective learning. This supports Nassoura's (2012) findings that students had positive attitudes toward e-learning due to its impact on motivation and self-esteem. The study found a significant difference between pre-test and post-test performances, favoring those exposed to the web-based authoring systems. This aligns with Makinde and Yusuf's (2017) findings, which showed significant performance differences between students taught using flipped classrooms and conventional methods. The superiority of computer animation over other methods may be due to several factors, including learners' ability to visualize 3D objects, immediate feedback, self-paced learning, reinforcement, mastery learning principles, associative learning, and step-by-step instruction.

This finding is consistent with Ebo (2017), who found significant differences in achievement scores between students taught basic technology using computer-mediated multiple intelligence instructional methods and conventional methods. Gambari, Falode, and Adegbenro (2014) reported significant differences in student achievements when taught geometrical concepts with computer animation. Similarly, Masoomeh (2014) showed that students taught in a weblog environment, using online instruction and practice, performed better in essay writing than those taught in traditional face-to-face environments. However, this finding contrasts with Akanmu (2015), who found no significant performance differences between students taught mathematics using GeoGebra software and those taught using conventional methods before treatment.

Regarding gender differences, the study found a significant difference in achievement between male and female students taught using WBAS. Ayodele (2011) also found that gender significantly affected students' achievement, with female students obtaining higher post-test scores than males. This finding concurs with Jegede and Okebukola (2006), who reported mixed results for gender achievement, with boys performing better in some tasks and girls in others.

Conclusion and Recommendation

The findings of this study revealed that the developed web-based authoring system enhanced undergraduate students' learning of communication process. Also, the respondents' attitude to the developed Web-based authoring systems was positive. This implies that the undergraduate students' exposure to the developed web-based authoring system brought about the students' attitudinal change in behaviour. Hence, there was significant difference in the performance of students exposed to Web-based authoring systems. Furthermore, this finding revealed that there was no significant difference between the achievement of male and female students taught using Web-based authoring systems. Finally, the study revealed that Web-based authoring systems facilitated the students' learning of communication concepts in Educational Technology. The study therefore recommends that Lecturers in the departments of Educational Technology and Computer science should be encouraged to use the developed Web-based authoring systems for effective teaching of communication concepts. Undergraduate students should also be encouraged to use the developed Web-based authoring systems to facilitate learning of communication

process due to positive attitude cultivated towards its usage, arouses students' interest and appeal to the sense of seeing and hearing.

References

Ayodele, K. (2011). Impact of gender on student achievement. *Journal of Educational Reearch and Development, 10*(2), 125-137.

Dee Fink, L. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. Jossey-Bass.

Ebo, J. (2017). Comparative analysis of instructional methods: Computer-mediated versus conventional. *Journal of Technology in Education, 15*(1), 45-58.

Gambari, I. A., Falode, O. C., & Adegbenro, D. A. (2014). Effectiveness of computer animation on students' achievement in geometrical concepts. *Educational Technology & Society, 17*(3), 167-179.

Jegede, O., & Okebukola, P. (2006). Gender differences in students' performance. *International Journal of Educational Management, 20*(5), 389-399.

Kirkpatrick, D. L. (2006). *Evaluating training programs: The four levels*. Berrett-Koehler Publishers.

Macedo, J., & Oliveira, P. C. (2024). Use of ICT to implement an active learning strategy in soil mechanics courses at undergraduate level. *Soils and Rocks, 47*(2), e2024007323.

Makinde, O., & Yusuf, F. (2017). Flipped classroom versus conventional teaching methods. *Journal of Educational Innovation, 14*(2), 75-89.

Masoomeh, E. (2014). Effect of weblog-based instruction on students' writing skills. *Journal of Educational Technology, 10*(1), 83-97.

Nassoura, A. (2012). Students' attitudes towards e-learning. *Journal of Educational Technology Research and Development, 60*(4), 661-677.

Oputa, D. (2014). Development of an interactive digital game for early childhood phonics education. *Journal of Early Childhood Education, 22*(3), 78-90.

Richey, R. C., Klein, J. D., & Nelson, W. A. (2004). *Developmental research: Studies of instructional design and development*. Routledge.

Salim, H. T., Rikabi, A. L., Jawad Al-Dujaili, M., Majeed, B. H., & ALRubeei, I. R. N. (2024). Information and Communication Technology and its Impact on Improving the Quality of Engineering Education Systems. *International Journal of Engineering Pedagogy*, *14*(1).

Salim, H. T., Rikabi, A. L., Jawad Al-Dujaili, M., Majeed, B. H., & ALRubeei, I. R. N. (2024). Information and Communication Technology and its Impact on Improving the Quality of Engineering Education Systems. *International Journal of Engineering Pedagogy*, *14*(1).

Yusuf, M. O., Fakomogbon, M. A., Mejabi, O. J., Tella, A., & Bolaji, A. J. (2017). Design of instructional content for mobile learning. *International Journal of Mobile and Blended Learning, 9*(1), 55-68.