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Comparing the Academic Achievement of Students Taught Educational Technology with Doodly-designed Multimedia Instructions in Classroom and Online Learning Environments

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Abstract

Background: The necessity of offering educational technology to students in the faculties of education calls for the effective diversification of instructional delivery environments. Using appropriate technologies while providing for the understanding of potential gender differences in response to multimedia instruction will inform educators on tailoring their approaches to optimise learning for all students.

Objective: This study compared the academic achievement of undergraduate students taught educational technology with Doodly-designed multimedia instructions in classroom and online learning environments.

Methodology: The 2x2 pre-test-post-test quasi-experimental factorial research design was utilised for the study. Three null hypotheses were formulated to guide the study. The study sample was made up of

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196 third-year students (92 males and 104 females), sampled via the combination of purposive and simple random sampling techniques. The Educational Technology Achievement Test (ETAT) served as the instrument for data collection. Three Educational Technology and 2 Educational Measurement experts served as validates. Kuder Richardson – 21 (K-R 21) statistical tool was used to test its reliability, which yielded a 0.92 reliability index. Data collected was marked, scored, coded and analysed using the Analysis of Covariance (ANCOVA) at 0.05 significance level.

Results: The outcomes disclosed that Doodly-designed multimedia instruction was statistically effective in enhancing undergraduate students' achievement in educational technology, both in the classroom and online. Also, the results showed that gender had no statistically significant influence on undergraduate students' achievement in educational technology. Additionally, the study's findings revealed that there was no interaction effect of Doodly-designed instructional multimedia and gender on undergraduate students' achievement in educational technology.

Conclusion: Based on the results, it was concluded that both classroom and online learning environments of Doodly-designed instructional multimedia were effective in enhancing undergraduate students' achievement in educational technology.

Unique Contribution: This research has contributed to the understanding of the effectiveness of Doodly-designed multimedia instruction for promoting better academic achievements in educational technology instructional delivery across the classroom and online learning environments and providing an explanation for the role of gender in multimedia learning.

Keywords: Comparing, Academic Achievement, Undergraduate Students, Educational Technology, Doodly-Designed Multimedia Instruction, Classroom and Online Learning Environments.

Introduction

The potency of multimedia instructions in achieving instructional objectives cannot be overemphasised. Multimedia tools like texts, graphics, audio, video and animations have, over the years, been utilised in various combinations for instructional delivery, using appropriate equipment and associated software packages (Abel, 2019; Titus, 2015). Learning with multimedia materials can surpass traditional teaching-learning in the achievement of instructional goals and objectives because it can effectively control the learning course and facilitate enhanced instructional outcomes (Kurtz, 2015). By being able to appeal to the senses of sight and hearing at the same time, it can better engage the learners and sustain their attention and interest (Mayer, 2014; Abel, 2019). According to Titus (2015), multimedia instructional packages are associated with basic features like relevance, accuracy, interest enhancement, purposefulness, minimised verbalism, improved comprehensibility, motivation, and realism. Notwithstanding the dynamic potentials of multimedia instructions, associated with multimedia instructional packages' design, production, and utilisation are issues of technical constraints, high cost of production and utilisation, high time consumption, poor technical know-how, poor power supply, lack of facilities, and the like; which result in the apathy of lecturers towards such instructional ventures (Johnson & Udo, 2020). Given the mentioned constraints, and in view of the revolution that technology has brought into education (Johnson et al., 2023), Doodly comes in handy to save the day by providing an innovative approach to creating engaging multimedia instruction through the use of its digital possibilities.

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Doodly, is simply a multimedia design software that makes it possible for the user to produce realistic multimedia with ease. Stranger (2021) saw it as a novel software, that permits the designer to make use of available images to design captivating multimedia. It makes numerous images available and allows users to upload and utilise personal images by using Doodly's smart drawing technology to create selected images. Since its introduction in 2017 by Brad Callen and Jimmy Kim of Bryxen Company, the software has been utilised by marketers, bloggers, YouTubers and animators to produce great animation videos without necessarily spending on exorbitant video equipment and software packages or multimedia design courses (Cloud, 2019). The software could be utilised on both Windows and Mac systems. Research suggests that Doodly-designed multimedia offers several potential benefits. Their informal style can create a less intimidating learning environment, increasing student engagement and enjoyment (Liu & Guo, 2020; Johnson et al., 2021a). Additionally, hand-drawn visuals can enhance cognitive processing and information retention compared to static presentations (Grabinger et al., 2019). While these studies highlight the potential advantages of Doodly-designed multimedia instruction, the specific effect on academic achievement, particularly within the realm of educational technology, remains less explored.

Research on the effects of multimedia instructional strategies shows that most of such instructional presentations were conducted in classroom environments (Ashaver & Igyuve, 2013; Herout, 2016). However, the issues of overpopulation of students in classrooms and poor/inadequate lecture venues have necessitated the adoption of blended, hybrid and virtual learning strategies. The availability of mobile gadgets makes it easy to deliver online instructions through an instant messaging software application. This takes care of the worries about delivering such packages to the learners. Such platforms also allow effective collaboration and interaction between lecturers and students. According to Pedro et al. (2018), being often connected to their mobile gadgets allows students to interact with online course content, potentially contributing to reconciling the existing barriers between education and real life. Abel (2019) supported the idea that mobile gadgets can effectively extend the learning environment and promote academic collaboration and knowledge construction. Generally, young people are presently more attracted to using mobile devices and associated applications for socialising, learning and networking. A well-designed, produced and delivered instructional content makes for the effective utilisation of devices, strategies and consistent adaptation of the realities of learners to the teaching-learning dynamics (Priyanka, 2018).

This study considers educational technology as an area of study within education, concerned with systematically identifying educational problems and finding practical and replicable solutions to them, using human and non-human resources to achieve replicable educational outcomes. Being offered as a one-semester, two-credit-unit course in the universities' faculties of education in Cross River State, the course outline for educational technology always has topics that are hardly effectively covered by the semester's end. Secondly, considering the high population of students, the lecturers-to-student ratio is grossly inadequate as there are very few educational technology specialists. This accounts for overcrowded classrooms since one lecturer must merge students from three or four departments and teach at the same time in a poor learning environment and without the utilisation of effective technological resources (Quaye et al., 2015). The students, most times, get jam-packed in lecture venues that cannot just accommodate a multitude, and they get lectured under very unconducive learning conditions where very few can sit on the seats, while some have to stand and others sit on the bare floor.

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This situation encourages students' absenteeism from classes, which is already a chronic issue associated with students in tertiary institutions (Johnson et al., 2021b). Quaye et al. (2015) lamented that even the students who attend classes end up being dissatisfied due to environmental factors and related issues, which tend to hinder instructional effectiveness. This situation tends to affect students' academic achievement in the course negatively.

Furthermore, gender-based research is essential for promoting gender equity and inclusion in tertiary institutions, especially because the findings along gender lines have been inconclusive due to the associated inconsistencies. Moreover, the experiences of male and female students in tertiary institutions tend to differ (Smith, 2015; Zambon, 2020), and the need to identify gender disparities and challenge gender stereotypes and biases made the researchers consider the need to explore the mediating influence of gender on students taught using Doodly-designed multimedia instruction across the classroom and online learning environments. In the instructional utilisation of Doodly-designed multimedia instruction, one cannot tell whether the classroom learning environment would be more effective than the online or the other way, especially when gender is used as a mediating variable. Hence, this study explored undergraduate students' academic achievement, taught using Doodly-designed multimedia instructions, across the classroom and online learning environments while checking the mediating influence of gender. This study was set out to:

i. Find out the difference in the mean achievement scores of classroom and online students taught Educational Technology with Doodly-designed multimedia instruction.
ii. Investigate the difference in the Mean achievement scores of male and female students taught Educational Technology with Doodly-designed multimedia instruction.
iii. Explore the interaction effects of environments of Doodly-designed multimedia instruction and gender on the mean achievement scores of students in Educational Technology.

Literature Review

Educational Technology

Educational technology is viewed as an area of study within which professional training on identifying and sustainably solving educational problems is provided for educational professionals. It is the study of the systematic and effective use of technological products, processes, and settings for instruction, training, and education (Inyang-Abia, 2015; Association for Educational Communication and Technology, 2018).

The course helps furnish students with needed principles, theories, and skills that empower them as trainee educational specialists to apply technological resources to identify educational problems and find effective, sustainable, practical, and replicable solutions to them using human and non-human resources. Scholarly works have stressed the essential role that educational technology plays in education (Mangal & Mangal, 2014; Sanders, 2017). The application of innovative ideas, skills, principles and technologies, as well as technology integration into instructional design, development, delivery, management and evaluation, are possibilities within educational technology. It is no wonder why educational technology is offered as a compulsory general course by third-year students in educational faculties in Cross River State universities.

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Doodly-Designed Multimedia Instruction

Doodly is simply a software package used to design and produce captivating multimedia for any desired purpose. Stranger (2020) and Woofresh (2021) saw Doodly as a computer-based application software used in creating whiteboard, blackboard, greenboard or glassboard multimedia. AP News (2021) defined it as animation software that allows anyone, regardless of technical or design skills, to create realistic multimedia within a short time frame. Accordingly, the designer can freely design multimedia on whiteboard, blackboard, greenboard, or glassboard without engaging in complicated hardware and software tools and processes.

Doodly has been used by content creators to easily design and produce their intended animation content with enhanced effectiveness. The software enables the designer to prepare intended multimedia in various MP4 file sizes for online shares and classroom utilisation (Woofresh, 2021). The software could be utilised on both Windows and Mac systems. A learner at the University level has many issues struggling for attention, which could be social, financial, academic, emotional and/or societal, which tend to hinder the effectiveness of learning (Johnson et al., 2021a). Therefore, effectively adopting a unique tool embedded with such dynamic instructional potentials and captivating abilities could be capable of sustaining the attention of the students as well as making the design and delivery of instructional content more effective and efficient.

Academic achievement

An evaluation of a given instructional exercise helps to provide feedback on the achievement of learning objectives, enabling the instructor to pass an objective judgement concerning the level of success or otherwise thereof. Kplovie et al. (2014) defined achievement as the measurable end result that shows the extent to which learners have realised laid-down instructional goals and objectives. The author added that it refers to what the students have learned or the level of skills acquired, which could be measured using standardised tests, performance assessment and/or portfolio assessment. In public tertiary institutions, the achievement is measured in terms of semester results obtained from continuous assessment and examination scores. Such results are computed into yearly Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), which is a computation of all the results at the end of the duration of an undertaken programme of study. It is considered in this research as the scores recorded by educational technology students, indicating the amount of learning that has taken place upon being exposed to the classroom and online Doodly-designed instructional multimedia. The measure of achievement using an Achievement Test would determine the extent of effectiveness of the instructional multimedia under study.

Gender

Gender has been found to have the ability to influence the learning outcomes of learners in tertiary institutions (Ashaver & Igyuve, 2013; Holmes & Reid, 2017). Yavuz (2016) and Zambon (2020) posited that gender provides a definition and differentiation between what men and women and boys and girls are expected to do and be along sociocultural lines. While gender disparities do not tend to set specific limits in learning, they do cause achievement variation among students, especially when exposed to similar learning resources and strategies (Ashaver & Igyuve, 2013; Holmes & Reid, 2017). At the tertiary level, students get into different activities that tend to engage both genders differently, which, by extension, tend to determine the amount and quality of time dedicated to academic work by each gender

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(Smith, 2015). Where the time put into studies differs due to other engagements, the academic outcomes may also differ. Having identified gender as having the ability to influence students' achievement, this study looked into the mediating influence of gender when learners are taught using the classroom and online environments of Doodly-designed instructional multimedia.

Cognitive Theory of Multimedia Learning (Mayer, 2014)

This theory, propounded by Richard E. Mayer in 2004 and reviewed in 2014, explains the principles that guide the instructional use of multimedia packages. According to the theory, the fundamental argument underlying research in multimedia learning is that well-designed multimedia lessons can potentially enhance better instructional communication and learning (Mayer, 2014).

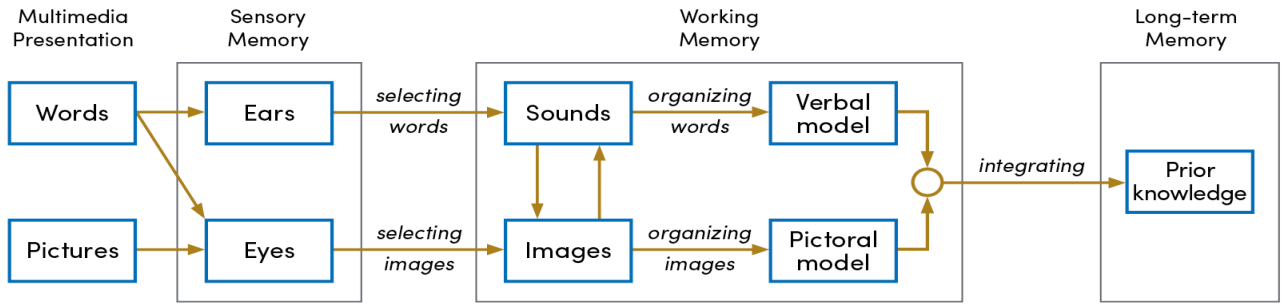

Fig. 1: Visual Representation of the Cognitive Theory of Multimedia Learning (Mayer, 2014).

According to Mayer (2014) and McGregor (2020), the theory specifies five cognitive processes in multimedia learning thus:

i. Selecting relevant words from the presented text or narration;
ii. Selecting relevant images from the presented graphics;
iii. Organizing the selected words into a coherent verbal representation;
iv. Organizing the selected images into a coherent pictorial representation; and
v. Integrating the pictorial and verbal representation and prior knowledge.

The theory informs the study that the words and graphics that make up the Doodly-designed instructional multimedia are principally crucial and impactful. Doodly-designed instructional multimedia upholds the design principles provided by the theory and provides logical verbal and pictorial information, guides the learners to sort out relevant words and images to link with prior knowledge, reduces the burden for a single processing channel, harnesses the essential and generative processing via dual-channel coding, eliminates the extraneous processing via its unique ability to compel attention, and ensures optimum instructional communication for maximal achievement of instructional goals and objectives.

Connectivism (Siemens, 2004)

This learning theory was propounded by Siemens in 2004 to address the missing links in other learning theories, such as behaviourism, cognitivism, and constructionism. The theory recognises technology's impact on society, resulting in a shift in thoughts on teaching and learning. Therefore, learning shifts

from being individualistic to relying on technology to provide connections between communities of practice, networks, and related tasks (Siemens, 2004). It basically explains the network of knowledge and learning through digital technologies. Though often considered as a learning and pedagogical theory, the theory emphasises the distribution of knowledge across a network of connections. Downes (2007) and Siemens (2008) maintained that learning in connectivism terms is a network phenomenon motivated by socialisation, technology, diversity, strength of ties, and context of occurrence.

The present study finds root in this theory in that the utilisation of Doodly-designed instructional multimedia provides connections that are required for students to be exposed to the elements of learning that extend beyond the classroom and allow for the self-paced and cooperative learning experience. The package also helps to reconcile the needs and intent of a learning exercise with the end user by forming the right technology-enabled connections. The study utilises the principles of connectivism to engage effective technological platforms to establish connections that exist socially (in the classroom) and in self-paced (online) learning, thereby enhancing effective instructional content delivery for maximising the achievement of instructional goals and objectives.

Development and Implementation of Doodly-Designed Multimedia Instructional Intervention

The Analysis, Design, Development, Implementation and Evaluation (ADDIE) Model, developed by Centre for Educational Technology, Florida State University (1975), was adopted to guide the process of the Doodly-designed multimedia instruction's design, development and implementation, thus:

Analysis - The learners, instructional content, multimedia, learning environments, and instructors were thoroughly scrutinised to ensure that they would effectively work in harmony towards achieving the instructional goals and objectives that were laid down. The learning needs of the third-year educational technology undergraduate students were ascertained via a preliminary study which was conducted by the researchers, using the Topic Difficulty Inventory (which made use of 100 respondents – 50 from each of the University of Calabar and University of Cross River State), to determine the topics that the students considered most difficult in their Course Outline on Educational Technology. Four topics emerged forthwith: Forms of Educational Technology, Components of Educational Technology, Information and Communication Technology, and Principles of Effective Improvisation. The Doodly-designed multimedia was adopted as an effective multimedia package that could serve both classroom and online learning. The researchers assessed themselves to ensure the competence required for effectively handling the design, development, implementation and evaluation of Doodly-designed multimedia instruction. The researchers also made provision to train four Educational Technology lecturers (two from the University of Calabar and two from the University of Cross River State), who were assigned to handle the course in the sampled departments on the effective design, development, implementation (in the classroom and online) and evaluation of an instructional exercise using Doodly-designed multimedia. The storyboard for the lesson was used as a training manual for training the lecturers.

Design - At this point, the researchers clearly determined the objectives of the instructional exercise to be embarked upon (using Doodly-designed multimedia for Educational Technology instructional delivery in the classroom and online). The researchers also developed a scripted storyboard on the four

topics selected via the preliminary study. The lesson contents were presented systematically. The procedure for implementation and evaluation was also clearly mapped out. The instruments for evaluating the lessons were equally put in place and aligned with the lessons' goals and objectives.

Development - The development of Doodly-designed multimedia followed the multimedia production process using the standard option of Doodly software. The need for the researchers-developed Doodly-designed multimedia was anchored on the fact that Doodly is a new software package with no instructional content readily available on the topics under consideration. Thus, the researchers launched the Doodly software on the computer system to produce the packages on the Doodly timeline. Upon doing so, the researchers translated the text on the storyboard to audio via the voicing-and-recording technique, where the text written on the storyboard was read and recorded using the Doodly software's timeline. The recorded audio was played back and edited to ensure perfection. Upon perfecting the audio, it was laid on the Doodly timeline and matched with appropriate texts and graphics before the 3D animated hand was selected to scribble them on the whiteboard. The final design was previewed, exported in MP4 format and made ready for the next stage. After expert reviews (by three Educational Technology, one Mass Communication and one Measurement and Evaluation expert) and recommendations (based on additional information needed and typing errors), corrections were made, and the final output exported was made ready for the classroom and online instructional delivery.

Implementation - After trial-testing the produced package on 100 students who were part of the study population but not part of the study sample and getting positive feedback, it was considered fit for the instructional exercise. Before the treatment, the test instrument was administered as a pre-test to ascertain the sampled respondents' knowledge level. The multimedia projector was used to project the instructional media in the classroom for the classroom group, using the prescription by Mangal and Mangal (2014). It was first played from beginning to end without any interruptions, and then observations were discussed before adopting the play and pause pattern to enable the students to take down notes. Each class lasted two hours, the stipulated time for educational technology classes. On the other hand, the online group had the same package delivered to them via a mobile application (WhatsApp) platform. Here, a group was created, and all the participants were added via their mobile numbers to access the packages as they were uploaded in MP4 format, which could play on every smartphone. The classroom group had their presentations made in the classroom by their two assigned educational technology lecturers. In contrast, the online group received theirs via the WhatsApp platform on their mobile gadgets. This was also delivered by their two assigned educational technology lecturers. WhatsApp was chosen because it is an instant messaging application that allows sharing such content, makes for interaction and can be easily installed and used on every smartphone. The entire process lasted for eight (8) weeks (two weeks for preparations ending with pre-test, four weeks for treatment and two weeks' gap before post-test, after treatment).

Evaluation - The research instrument, which was first administered at the point of the pre-test to the sampled students, was re-administered at the point of the post-test, with all the items re-arranged. The data generated from the pre-test and post-test was marked, scored, coded and analysed to determine the effect of Doodly-designed multimedia instruction on undergraduate students' academic achievement in Educational Technology in classroom and online learning environments.

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Research Hypotheses

Three research hypotheses were put forward to help achieve the objectives of this study:

iv. There is no statistically significant difference in the mean achievement scores of classroom and online students taught Educational Technology with Doodly-designed multimedia instruction.

v. There is no statistically significant difference in the Mean achievement scores of male and female students taught Educational Technology with Doodly-designed multimedia instruction.

vi. There is no statistically significant interaction effect of environments of Doodly-designed multimedia instruction and gender on the mean achievement scores of students in Educational Technology.

Research Method

The 2x2 pre-test and post-test quasi-experimental factorial research design was used for the research. 196 third-year students (92 males and 104 females) were sampled via a combination of purposive and simple random sampling techniques. The choice of third-year students was based on the fact that Educational Technology is offered as a faculty-wide course by third-year students in the faculties of education and the topics treated (Forms of Educational Technology, Components of Educational Technology, Information and Communication Technology and Principles of Effective Improvisation) on the Doodly-designed multimedia instructions were identified via a preliminary study which was used to identify the most difficult topics on the course outline on Educational Technology. The sampled departments were randomly placed in classroom and online groups via the coin-tossing randomisation strategy. A representative from each side chose a side of a coin. When the coin was tossed up and allowed to land, the side that faced up was used for the classroom group, while the side that faced down was used for the online group. The researchers developed the Educational Technology Achievement Test (ETAT), which served as an instrument for data collection. It was made up of 50 test items with options A to D, with only one being correct. The instrument was validated by 3 Educational Technology and 2 Tests and Measurements experts. The internal consistency of ETAT was measured via Kuder Richardson – 21 (K-R 21), and 0.92 was obtained as the reliability index. The instrument was administered during the pre-test before the treatment and at the post-test (with items rearranged) after the treatment. Data collected was sorted, marked, scored, coded and analysed using the IBM Statistical Package for Social Sciences (SPSS), version 23. The Analysis of Covariance (ANCOVA) was used in testing all the hypotheses at 0.05 levels of significance.

Table 1: Results of Test of Normality Analysis.

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Instructional Modes.	Statistic	Df	Sig.	Statistic	Df	Sig.
Pre-test Edu Tech Achievement	Classroom Instructional Mode	.111	105	.003	.978	105	.006
	Online Doodly Instructional Mode	.064	91	.040*	.988	91	.004

Post-test Edu Tech Achievement	Classroom Instructional Mode	.129	105	.000	.968	105	.012
	Online Doodly Instructional Mode	.098	91	.032	.983	91	.024

The data on table 1 reveals the Shapiro-Wilk test of normality of the data sets. Considering that the associated probability (Sig.) values are less than 0.05 at which the results were tested, the data is therefore adjudged to be normally distributed. This makes it suitable for ANCOVA to be used in testing the hypotheses at 0.05 significance level.

Study Results

The result of the study is presented below:

H1: There is no statistically significant difference in the mean achievement scores of classroom and online students taught Educational Technology with Doodly-designed multimedia instruction.

Table 2: Analysis of Covariance (ANCOVA) of the Difference in the Mean Achievement Scores and Gender of Students taught Educational Technology using Classroom and Online Doodly Animation Instructional Modes.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared (η^2_p)	Dec.
Corrected Model	12252.493[a]	4	3063.123	51.455	.000	.519	
Intercept	6515.689	1	6515.689	109.453	.000	.364	
Pretest Edu.T. Achvt.	9316.960	1	9316.960	156.509	.000	.450	
Group	19.822	1	19.822	.333	.565	.002	NS
Gender	10.570	1	10.570	.178	.674	.001	NS
Group * Gender	18.750	1	18.750	.315	.575	.002	NS
Error	11370.181	191	59.530				
Total	563008.000	196					
Corrected Total	23622.673	195					

Note: df = Degree of Freedom, F= F-ratio, Sig.= Significant/probability value, Dec.= Decision, NS = Not Significant, S = Significant.

Table 2 shows that there is no significant difference in the mean achievement scores of students taught Educational Technology using classroom and online Doodly-designed multimedia instruction (F (1, 191) = .333, p = .565, η^2_p = .002). This is because the associated probability (Sig.) value of .565 is greater than the 0.05 level of significance at which the result is being tested. Moreover, the effect size difference

(η^2_p = .002) indicates a 0.2% variance between the mean achievement scores of students taught using the two instructional environments. This implies that no significant difference exists between the effects of classroom and online Doodly-designed instructional multimedia environments on the mean achievement scores of students in Educational Technology.

H2: There is no statistically significant difference in the Mean achievement scores of male and female students taught Educational Technology with Doodly-designed multimedia instruction.

Table 2 also indicates the ANCOVA analysis result, which shows that the difference between the mean achievement scores of male and female students in Educational Technology is not statistically significant (F (1, 191) = .178, p = .674, η^2_p = .001). This is because the associated probability (Sig.) value of .674 is greater than the 0.05 level of significance at which the result is being tested. This implies that gender did not significantly influence students' achievement in Educational Technology when taught using Doodly-designed multimedia instructions across classroom and online environments.

H3: There is no statistically significant interaction effect of environments of Doodly-designed multimedia instruction and gender on the mean achievement scores of students in Educational Technology.

The result in Table 2 further reveals ANCOVA analysis that the interaction effects of environments of Doodly-designed multimedia instruction and gender on the mean achievement score of students in Educational Technology are not statistically significant (F (1, 191) = .315, p = .575, η^2_p = .002). This is because the associated probability (Sig.) value of .575 is greater than the 0.05 level of significance at which the result is being tested. Moreover, the effect size difference of η^2_p = .002 indicates that 0.2% variance in the mean achievement scores of students is attributable to the interaction effects of environments of Doodly-designed multimedia instruction and gender. Hence, the inference drawn is that the interaction effects of environments of Doodly-designed multimedia instruction and gender on the mean achievement scores of students in Educational Technology are not statistically significant. Figure two (2) also reveals that there are no significant interaction effects of modes of Doodly animation instructional media and gender on the mean achievement score of students in Educational Technology. This is evident as the lines drawn against the instructional modes and gender do not intercept at any point. The graph is as shown below.

Figure 2: Profile plot for interaction effects of environments of Doodly-designed multimedia instruction and gender on the mean achievement score of students in educational technology.

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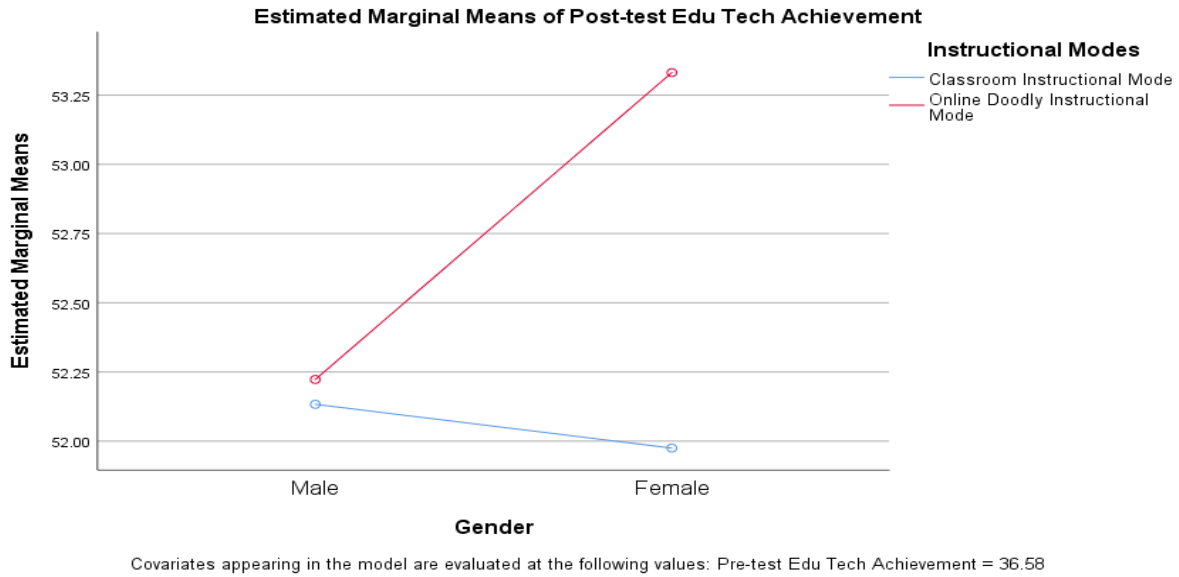

The profile plot above (Figure 2) indicates that there were no significant interaction effects of environments of Doodly-designed multimedia instruction and gender on the mean achievement score of students in Educational Technology. This is evident because the lines drawn against the instructional modes (environments) and gender in the graph are parallel and do not intercept at any point. The marginal mean in the graph for the classroom instructional environment was 48.85, while that of the online environment was 58.40, irrespective of the student's gender. This indicates that environments of Doodly-designed multimedia instruction and gender did not interact at any point to produce an effect on the mean achievement scores of educational technology students.

Discussion of Findings

The results of the study indicated that both classroom and online environments of Doodly-designed multimedia instruction have positive effects on the academic achievement of students in Educational Technology. The findings revealed that the adjusted mean scores of students in both experimental groups were improved, indicating a positive effect of environments of Doodly-designed multimedia instruction. This result could be because of the ability of Doodly-designed multimedia instruction to captivate attention and communicate the intended instructional message across both learning environments. The outcome of this study agrees with the study of Kemp and Grieve (2014) and, Paul and Jefferson (2019) revealed that multimedia instructional packages are effective for both classroom and online instructional delivery. Kemp and Grieve, and Paul and Jefferson made use of multimedia instructional packages to teach university undergraduates and studied their comparative effectiveness for classroom and online learners. In the same vein, the present study made use of Doodly-designed multimedia instruction to find out the comparative effectiveness of classroom and online learning and proved that multimedia packages can generate the same effect across the two environments of instructional delivery. In view of the above, Titus (2015) and Herout (2016) posited that multimedia packages are associated with basic features like relevance, accuracy, interest enhancement, purposefulness, improved comprehensibility, motivation and realism; therefore, when well administered, can improve the course of learning and increase the chances of achieving laid down learning goals and objectives, especially by its ability to engage the audio and

visual senses of the learners. This is typically underscored by the effectiveness of Doodly-designed multimedia instruction, as proven by this study.

Regarding the influence of gender on academic achievement of students in Educational Technology, this study found out that gender had no significant influence on the mean achievement scores of undergraduate educational technology students taught with Doodly-designed multimedia instruction. This result is in corroboration with those of Dania (2014), Eze et al. (2016), Ajayi and Ogbeba (2017) and Ogundola et al. (2020) which held that both genders showed no difference in their academic achievements but gained significantly after being exposed to multimedia treatments. This implies that, upon exposing the learners to Doodly-designed multimedia instruction, both genders maximally benefitted without any limitation. The study showed that Doodly-designed multimedia instruction duly accommodated the instructional needs and challenges of both genders.

Furthermore, it was also statistically proven from this study that significant improvement in the achievement of undergraduate educational technology students was a result of the effectiveness and efficiency of Doodly-designed multimedia instruction and not as a result of dependence on gender. This is why the result shows that there is no significant interaction effect of environments of Doodly-designed multimedia instruction and gender on the mean achievement scores of students in Educational Technology. This finding corroborates those of Nwosu and Ndanwu (2020) and Nkok and Enang (2022), whose studies found that gender and instructional multimedia had no interaction effects on the academic achievement of students.

Conclusions and Recommendations

In line with the research findings, it was concluded that both classroom and online environments of Doodly-designed multimedia instruction are effective on undergraduate students' achievement in Educational Technology. This means that when teaching Educational Technology to undergraduate students, lecturers could adopt Doodly-designed multimedia to effectively deliver their instructional contents both in classroom, using multimedia projector; and online, using a mobile application on mobile devices. Also, gender had no significant influence on undergraduate students' academic achievement when taught Educational Technology with classroom and online Doodly-designed multimedia instruction. Finally, there was no significant interaction effect of environments of Doodly-designed multimedia instruction and gender on undergraduate students' academic achievement in Educational Technology. Therefore, the study proposes as follows:

i. Educational Technology lecturers and other course lecturers should adopt the Doodly-designed multimedia for effective classroom and online instructional delivery.
ii. Lecturers should take full advantage of the instructional possibilities associated with Doodly-designed multimedia instruction to accommodate the learning needs of both genders of the university undergraduate students. They should utilize the classroom and online Doodly-designed multimedia environments to effectively diversify their instructional delivery and enhance the academic achievement of students across gender lines.
iii. The university management should organize conferences, workshops, and seminars for lecturers on a regular basis to expose them to theoretical and practical knowledge about the design,

development, and implementation of Doodly-designed multimedia for effective classroom and online instructional delivery.

iv. The government and policymakers should make funds available for the purchase of needed equipment and software packages and the creation of an enabling environment for the effective design, development and utilisation of Doodly-designed multimedia instruction for classroom and online instructional delivery.

v. Further studies should be conducted on the effects of Doodly-designed multimedia instruction on other courses of study or the practical aspect of Educational Technology, to further ascertain the effectiveness thereof.

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