Doodly-Based Multimedia Instructional Intervention and Academic Achievement of Undergraduate Students with Learning Disabilities in Educational Technology

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Abstract: Traditional instructional strategies may not provide the essential elements necessary for students with learning disabilities (LDs) to learn effectively. This ultimately leads to decreased motivation and underachievement. Since Doodly-based multimedia has been scientifically proven to enhance learning outcomes, one wonders if such effects could be replicated on the academic achievement of students with LDs. The study explored the impact of Doodly-based multimedia instructional intervention (DBMII) on the academic achievement of undergraduate students with LDs in Educational Technology (EdTech). The research employed a 2x2 quasi-experimental factorial design, with pre- and post-tests to explore the effects of DBMII. The census sampling technique was used to draw a sample of 38 (22 males and 16 females) third-year special education students with confirmed cases of LDs. The data collection used the Educational Technology Achievement Test (ETAT). The validation was conducted by three specialists and had a reliability coefficient of 0.82 using the Kuder-Richardson 21 formula, before it was administered, marked, scored, coded, and analyzed. Analysis of Co-Variance (ANCOVA) was employed to test the hypotheses, setting the significance threshold at the 0.05 level. The findings revealed a statistically significant beneficial effect of DBMII on the academic achievement of undergraduate students with learning disabilities in EdTech. Also, gender did not significantly influence educational achievement, and no interaction effects between gender and Doodly-based multimedia instructions were observed. It was concluded that Doodly-based multimedia instructions have a statistically significant beneficial effect on the academic achievement of undergraduate students with LDs in EdTech, without any significant influence of gender.

Keywords: Doodly-based multimedia instructions, multimedia instructions, learning disabilities, academic achievement, educational technology, undergraduate students, gender.

1. INTRODUCTION

The brain-based conditions that interfere with learning and information processing are referred to as learning disabilities (LDs). At the undergraduate level, such conditions continue to prove more challenging to address, and the difficulties typically manifest more in advanced courses, such as EdTech, due to the theoretical background and practical applications associated with the course [1]. Notably, the lecture method has been the prevalent instructional presentation method, where lecturers dictate lecture notes, offer explanations, and answer questions that arise. This pattern is inadequate in engaging the students with LDs, thereby inhibiting their chances of retaining instructional information [2]. This situation also tends to make instructional delivery an unexciting event, which further leads to a lack of learning motivation and ultimately results in students lagging in their academic achievement [3]. Since research in the last few decades has explored multimedia instructions as an effective tool for improving teaching and learning [4], investigating the instructional effectiveness and efficiency of an innovative multimedia technology like Doodly would be a timely and worthwhile scientific exercise.

Doodly can be described as a whiteboard, blackboard, glassboard, or greenboard animation software package that uniquely combines audio and visual signals in a way that simplifies complex concepts and makes instructional communication more engaging for the learner [5]. It can be used to create interactive, hand-drawn animations that connect with the visual and kinesthetic learning styles often present in students with LDs [6]. The effective instructional utilization of multimedia designed with visual elements provided by Doodly could enhance information processing and retention among students with LDs. Through the breakdown of complex concepts into visually appealing

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units, Doodly can reduce cognitive overload and facilitate a better understanding of lesson content [4]. Due to its intrinsic ability to support both classroom and virtual teaching/learning, Doodly-based multimedia instructions can be flexible, accessible, and provide extensive learning opportunities. Previous research has indicated that visual aids and animation can promote the achievement of instructional goals and objectives among students with LDs [6]. In addition, Dual Coding Theory posits that information is processed through both oral and visual channels, and that understanding and memorization are enhanced when both channels are utilized [4].

Academic achievement is an aspect of measuring the effectiveness of a teaching-learning exercise through an achievement test. The selection of academic achievement as a primary dependent variable is rooted in its confirmed role as the primary determinant of instructional effectiveness [1]. This study identifies and employs indicators that promote students' learning and academic achievements in the complex discipline of EdTech, aiming to meet broader educational research goals through the use of researchers' adapted achievement test for efficient data collection, addressing measurable learning outcomes. Gender may serve as a mediator in the effectiveness of Doodly-based multimedia instruction.

There is a need for scientific evidence as to whether cognitive processing and learning styles differ according to gender. Research has suggested that males prefer higher visual-space learning than females, who have a higher advantage in oral-based learning [7]. Research has also confirmed that males and females have different interactions and perceptions of multimedia and digitalized learning environments [6]. It is there fore pertinent to find out whether gender could influence the effects of Doodly-based multimedia instructions on the academic achievement among undergraduate students with LDs in EdTech.

Additionally, there is a need to scientifically test the effectiveness of DBMII in improving the academic achievement of students with LDs in EdTech because there is no empirical evidence to that effect. This research, therefore, seeks to explore the impact of Doodly-based multimedia instructionson the academic achievement of learners with LDs. In specific terms, this study aims at:

i. Find out the effects of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

ii. Investigate the moderating influence of gender on the effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

iii. Explore the interaction effect of gender and Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

2. MATERIALS AND METHODS

2.1. Methodology

This study employed a 2x2 quasi-experimental factorial design, utilizing pre- and post-tests to evaluate the effects of Doodly-based multimedia instructions. A sample of 38 third-year special education students (22 males and 16 females) with confirmed learning disabilities was selected using the census sampling technique. Third-year students were chosen because they are required to enroll in the faculty-wide EdTech course. With the assistance of the two heads of department and one assigned lecturer, intact classes comprising of 136 (males = 85, females = 51) students (54 from the Special Education Department unit of Guidance and Counselling Department, University of Cross River State (Unicross), and 82 from Special Education Department, University of Calabar (Unical)), were used for the study.To avoid stigmatization, all students participated in the exercise; however, only the instruments from the actual confirmed students with learning disabilities, as reported by each department, were sorted out via special codes and used for the study. The instructional content, covering complex subjects such as Forms of EdTech, Components of EdTech, Information and Communication Technology (ICT) in Education, and Principles of Effective Improvisation in Education, was adapted from [1] and used according to a preliminary needs analysis. The study utilized two intact classes, with participants from the two institutions randomly assigned to controlled and experimental groups. The controlled group (Unicross) was taught using the lecture method.

In contrast, the experimental group (Unical) was taught using diversified modes, where classroom presentations utilized a multimedia projector, and complementary online presentations were delivered via the WhatsApp platform. Researchers adapted the EdTech Achievement Test (ETAT), a 50-item multiple-choice assessment, for data collection purposes. The validity of ETAT was ensured through expert review,

with one expert each from EdTech, Special Education, and Public Health. The reliability was assessed using the Kuder-Richardson 21 formula, which produced a coefficient of 0.82. Pre- and post-tests were administered with re-arranged questions. The intervention exercise took two weeks. Data analysis was performed using Analysis of Covariance (ANCOVA) after a test of normality, in SPSS version 27.The use of ANCOVA aims to mitigate the limitations associated with the small sample size and quasi-experimental design in this study, which may impact the generalizability of the overall research findings. All the hypotheses were tested at the 0.05 level of significance. The results of the preliminary data analysis are presented in Tables **1** and **2** below.

2.2. Literature Review

2.2.1. Educational Technology (EdTech)

This study considers EdTech as a course of study that focuses on integrating theoretical and practical knowledge with digital tools to identify educational problems and provide practical and scientific solutions, thereby improving educational activities and outcomes. The course aims to equip learners with knowledge of dynamic educational principles, techniques, and technologies [8]. The undergraduates with LDs face unique learning difficulties in this area of study due to their different learning needs and styles, in addition to the high demand for information processing. Effective instructional deliveryin this course requires individualized learning and the effective use of digital tools and multimedia, which can lead to better engagement, knowledge acquisition, and retention.

Given the evident complexity of EdTechas a course of study, Doodly's rich instructional potential is essential for simplifying ideas and facilitating effective learning. The effectiveutilization of multimedia for instructional delivery has been shown to promote understanding among students with diverse learning needs [4]. One wonders if Doodly could fulfil the individual learning needs of students with LDs and improve their academic achievement in EdTech.

2.2.2. Doodly-Based Multimedia Instructions

Doodly is a computer program that is compatible with Windows and Mac operating systems, used to create multimedia whiteboards, blackboards,

Table 1: Test of Normality Analysis

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Instructional Modes	Statistic	Df	Sig.	Statistic	df	Sig.
Pre-test Edu Tech Achievement	With Doodly-based Multimedia Instructions	0.191	21	0.045	0.882	21	0.016
	Without Doodly-based Multimedia Instructions	0.128	17	0.200*	0.973	17	0.873
Post-test Edu Tech Achievement	With Doodly-based Multimedia Instructions	0.112	21	0.200*	0.957	21	0.463
	Without Doodly-based Multimedia Instructions	0.107	17	0.200*	0.977	17	0.921

*This is a lower bound of the true significance.
[a]Lilliefors Significance Correction.

Table 2: Tests of Homogeneity of Variances

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Pre-test Edu Tech Achievement	Based on Mean	1.183	1	36	0.284
	Based on Median	1.354	1	36	0.252
	Based on Median and with adjusted df	1.354	1	35.999	0.252
	Based on the trimmed mean	1.300	1	36	0.262
Post-test Edu Tech Achievement	Based on Mean	0.027	1	36	0.869
	Based on Median	0.014	1	36	0.908
	Based on Median and with adjusted df	0.014	1	35.877	0.908
	Based on the trimmed mean	0.021	1	36	0.885

greenboards, or glassboards. It enables the quick creation of realistic multimedia, regardless of the user's design or technical skills [5]. The Doodly-based multimedia instructions use animation with hand-drawn visuals and synchronized voiceovers, which improves learning by aligning with cognitive load theory. The technique breaks down complex information into visually appealing pieces, fighting cognitive overload and increasing processing [4]. The interactive nature of Doodly, presenting ideas in real-time, could support visual and kinesthetic learning, which benefits students with LDs who often struggle with traditional knowledge, which is typically text-based and lecture-based.

Doodly thrives on the principles of multimedia learning, which emphasizes dual coding based on verbal and graphic channels [4]. It supports students' better mental picture of the material, which can increase understanding and academic success, especially in educational technology, where visualization is essential. The active and attractive potential of Doodly could capture and sustain attention, thereby supporting the design and presentation of teaching-learning materials, especially among undergraduate students with LDs.

2.2.3. Academic Achievement

This study considers academic achievement as the provable knowledge and skills acquisition level attained by undergraduate university students with LDs in EdTech. [9] see it as a multifaceted construct, usually measured through appropriate tests, which focuses on specific lesson contents and skills mastery. Measurements like these provide adequate indices for evaluating the knowledge gained, which can be used to judge the effectiveness of an educational intervention, such as the Doodly-based multimedia instructional delivery [1]. Academic achievement is not only judged through scores in assessments. It also entails understanding critical thinking, problem-solving, and the practical application of the knowledge and skills learned [10].

To accurately measure academic achievement in this study, an achievement test was adapted from [1]. The test was customized to measure students' knowledge of essential concepts and ability to apply them to daily situations related to EdTech. The use of achievement tests will enable a systematic and objective assessment of the effects of Doodly-based multimedia instructions, which would scientifically prove the efficiency or otherwise of the intervention.

2.2.4. Learning Disabilities

Learning disabilities (LDs) result from problems in the nervous system that affect an individual's ability to learn, store, analyse, and use information. They have a profound impact on tertiary students, both in terms of achieving academic goals and overall quality of life. Some of the most prevalent LDs within the research population include dyslexia, dysgraphia, and attention deficithy per activity disorder (ADHD). Dyslexia is a disability that affects reading and spelling and may prevent students from understanding complicated tertiary readings [11] and completing writing tasks. Dysgraphia, a writing disorder, causes challenges with handwriting, spelling, and the translation of words into written language, usually resulting in frustration and lower scores [12]. ADHD also interferes with focus, time management, and planning, or makes students lose attention in class [13]. They pose significant obstacles to academic goals, which require appropriate accommodations and support services in the university environment.

Recent studies have highlighted the urgent need for early detection and treatment to mitigate the effects of LDs on university students, as well as the impact of various support mechanisms, such as kinesthetic teaching, individually tailored learning strategies, and intensive tutoring [11]. Studies have also pointed out the coexisting conditions of LDs with mental health disorders, including depression and anxiety, and asked for a comprehensive support system that meets both academic and emotional needs [12].Creating targeted interventions for diagnosed cases of LDs among university students will facilitate their educational and personal achievements.

2.2.5. Gender

Gender is a socio-cultural factor that could influence learning and academic achievement, especially in the context of instructional interventions. In studying the effects of multimedia instructions on learners with LDs, considering the influence of gender in cognitive processing, learning style, and technology utilization could be beneficial [8]. Failure to assess the impact of gender in research like this one may obscure the differential effects of the intervention, which in turnmay hinder the generalizability and applicability of the overall results. The influence of gender can also be observed in the dimensions of audio and visual learning styles, which are crucial factors in multimedia-based instructional delivery [14].

As a moderating variable, gender provides a more balanced investigation of how multimedia-based interventions interact with changes in learners with LDs, specifically those of male and female learners. In addition, the analysis of gender's influence in the context of LDs and multimedia-based learning leads to inclusive and fair educational strategies that emphasize equal access to learning opportunities for all students [15].

2.2.6. Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2014)

This theory postulates that effective learning occurs when learners actively construct mental structures by integrating visual and audio-based information [4]. Based on the tenets of this theory, Doodly-based instructional multimedia provides animation and narration to help learners with LDs in processing and retaining instructional information. Doodly-based instructional multimedia design helps ensure active participation from learners by harmoniously stimulating their visual and auditory senses.

This research relies on the theoretical foundation provided by the CTML and investigates whether DBMII could encourage active cognitive processing, reduce irrelevant cognitive load, and promote essential processing. The study will scientifically find out whether the intervention supports the fundamental tenets of the CTML.

2.3. Doodly- Multimedia Instructional Intervention

The ASSURE Model, by [16], was adopted to guide the DBMII, thus:

A -Analyse Learners: This focused on a thorough assessment of the third-year special education students in Unical and Unicross; specifically, those with confirmed cases of LDs, which formed the research population. Four significant topics—Forms of EdTech, Components of EdTech, Information and Communication Technology (ICT) in Education, and Principles of Effective Education—were addressed in the instructional packages. The lead researcher further underscored the value of personal competence by conducting training sessions for the other researchers on the effective use of Doodly for instructional design and implementation, using the storyboard as an instructional guide.

S - State Objectives: After analysis, the state objectives step constituted the precise formulation of instructional expectations in measurable terms. The objectives aimed at enhancing students' knowledge of the four challenging topics identified and their academic achievement in EdTech.

S - Select Methods, Media, and Materials: This aimed at choosing appropriate instructional methods and materials. A multimedia projector was selected for the classroom environment, with the duplicate content also provided online to the experimental group via the WhatsApp mobile application. Doodly-based instructional multimedia was the chosen intervention medium, adopted from the research by [1].

U - Utilize Media and Materials: This phase involved using the adapted Doodly-based multimedia intervention materials to present the instructions. The researchers analyzed the Doodly-based multimedia instructional materials to ensure clarity, accuracy, and a focus on context. The control group was taught using the traditional lecture method, while the experimental group received a combination of classroom and online presentations of Doodly-based multimedia instructions. At the school, the videos were displayed using a multimedia projector, followed by discussions and note-taking exercises. It was complemented by online presentations administered through a dedicated WhatsApp group created for all study participants in the experimental group. The principal researcher, who is a lecturer in EdTech, was present to guide the discussions and respond to questions in both settings.

R - Require Learner Participation: This step was fulfilled by incorporating interactive aspects in the pedagogical strategies for both controlled and experimental groups. In face-to-face settings, students conversed and took notes on key points. Online, which served as an alternative for the experimental group, students interacted by watching multimedia at their convenience and participating in online discussions. The interactive nature of Doodly-based multimedia instructions, combined with the pause-and-discuss method employed in the classroom, created a conducive environment for active learning in the experimental group. The availability of one-on-one support was also incorporated to ensure accessibility and interactivity.

E - Evaluate and Revise: Lastly, the evaluate and revise phase involved assessing the effectiveness of the intervention. The pre-test and post-test were administered, and the scores obtained were compared to quantify learning progress. The entire exercise

covered a period of two weeks. The expert review of the Doodly-based multimedia created useful information that would be employed in revising the Doodly-based multimedia instructions for future implementation.

4. Research Hypotheses

The following research hypotheses were advanced for scientific testing:

i. There is no statistically significant effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

ii. There is no statistically significant moderating influence of gender on the effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

iii. There is no statistically significant interaction effect of Doodly-based instructional multimedia and gender on the academic achievement of undergraduate students with LDs in EdTech.

2.5 2.5. Test of Normality

According to the results in Table **1**, the Shapiro-Wilk test was used to assess the normality assumption. For the pre-test EdTech achievement scores, the group with Doodly-based Multimedia Instructions (W = 0.882, p = 0.016) significantly deviated from normality. In contrast, the group without Doodly-based Multimedia Instructions (W = 0.973, p = 0.873) did not. For the post-test scores, both the group with (W = 0.957, p = 0.463) and without Doodly-based multimedia Instructions (W = 0.977, p = 0.921) met the assumption of normality. In addition, normality was tested across gender. The result showed that both male and female groups showed no significant deviation from normality for both the pre-test (male: W = 0.953, p = 0.363; female: W = 0.955, p = 0.568) and post-test scores (male: W = 0.980, p = 0.917; female: W = 0.955, p = 0.573). Notably, although one group (the experimental group in the pre-test) slightly violated normality (p = 0.016 in the Shapiro-Wilk test), ANCOVA is robust in handling minor deviations from normality, especially with sample sizes as large as those in this study (n = 21 and n = 17). Furthermore, Levene's Test for Equality of Variances showed that the assumption of homogeneity of variances was met for both pre-test (F(1, 36) = 1.18, p = 0.284) and post-test (F(1, 36) = .03, p = 0.869) achievement scores. The results are presented in Table **2** above.

3. RESULTS

HO1: There is no statistically significant effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

The results in Table **3** show that the effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech is statistically significant (F (1, 37) = .152.193, p = .000, η2p = .822). This is because the associated probability (Sig.) value of .000 is less than the 0.05 level of significance at which the result was being tested. Moreover, the effect size difference (η^2p = 0.822) implies that 82.2% of the variance in the

Table 3: Analysis of Covariance (ANCOVA) of the Difference in the Mean Achievement Scores and Gender of Students taught EdTech with and without Online Doodly Instructions

Source	Type III Sum of Squares	Df	Mean Squaxre	F	Sig.	Partial Eta Squared (η^2_p)	Dec.
Corrected Model	6607.501[a]	4	1651.875	62.170	0.000	0.883	
Intercept	1006.002	1	1006.002	37.862	0.000	0.534	
PretestETA	1324.209	1	1324.209	49.838	0.000	0.602	
Group	4043.802	1	4043.802	152.193	0.000	0.822	NS
Gender	2.752	1	2.752	0.104	0.750	0.003	NS
Group * Gender	0.065	1	0.065	0.002	0.961	0.000	NS
Error	876.815	33	26.570				
Total	103286.000	38					
Corrected Total	7484.316	37					

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

academic achievement of undergraduate students with learning disabilities in EdTech is explained by the effect of Doodly-based multimedia instructions.

Ho2: There is no statistically significant moderating influence of gender on the effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

Result in Table **3** also indicates ANCOVA analysis results, which revealed that the moderating influence of gender on the effect of Doodly multimedia instructions on the academic achievement of undergraduate students with learning disabilities in EdTech is not statistically significant (F (1, 37) = 0.104, p = 0.750, η2p = 0.003). This is due to the fact that the associated probability (Sig.) value of 0.750 is higher than the 0.05 level of significance at which the result was being tested. This therefore signifies that gender has no significant moderating influence on the effect of Doodly-based multimedia instructions on the academic achievement of undergraduate students with LDs in EdTech.

Ho3: There is no statistically significant interaction effect of Doodly-based instructional multimedia and gender on the academic achievement of undergraduate students with LDs in EdTech.

Results in Table **3** further indicate ANCOVA analysis which showed that the interaction effect of instructional multimedia and gender on the academic achievement of undergraduate students with learning disabilities in EdTech is statistically significant (F (1, 37) = 0.002, p = 0.961, η2p = 0.000). This is because the associated probability (Sig.) value of 0.961 is greater than 0.05 level of significance at which the result was being tested. Moreover, the effect size difference of η2p = .000 suggests that no variance exists in the academic achievement of undergraduate students with learning disabilities in EdTech due to the interaction effect of instructional multimedia and gender. Therefore, the inference drawn was that there is no statistically significant interaction effect of instructional multimedia and gender on the academic achievement of undergraduate students with learning disabilities in EdTech. This is buttressed by the result in Figure **1** below.

The profile plot above (Figure **1**) indicates that there was no significant interaction effect of instructional modes and gender on the academic achievement of undergraduate students with LDs in EdTech. The drawn lines in the instructional multimedia and gender graph, parallel to each other and not crossing at any point, further indicate the lack of an interaction effect.

4. DISCUSSION

The study's findings clearly revealed that Doodly-based multimedia instructions effectively improved the academic achievement of undergraduate students with LDs in EdTech. Students exposed to Doodly-based multimedia instructions achieved significantly higher post-test scores compared to their counterparts who were not exposed to such instructions. This outcome may be due to the engaging and visually stimulating nature of Doodly-based multimedia, which combines animated whiteboard visuals with synchronized sound to convey instructional content. This finding aligns with that of [1], which demonstrated that Doodly-based

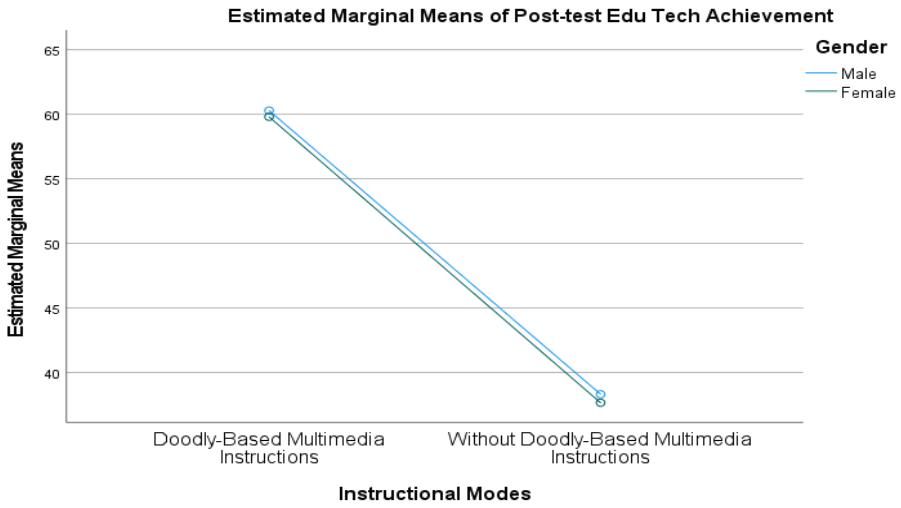

Figure 1: Covariates appearing in the model are evaluated at the following values: Pre-test Edu Tech Achievement = 35.34.

multimedia instructional packages lead to improved learning outcomes. [17] Further support this outcome by acknowledging that multimedia instruction promotes an inclusive learning environment, especially for students with learning difficulties, by simplifying complex content into digestible units and formats.

The study also discovered that gender did not have any significant influence on the effects of Doodly-based multimedia instruction on the academic achievement of undergraduate students with LDs in EdTech. The implication, therefore, is that the male and female students with LDs benefited equally from the multimedia instructional intervention. This result is consistent with the work of [7], which found no significant influence of gender on students' academic performance after exposure to multimedia teaching methods. Both studies emphasized the importance of inclusive multimedia design, which accommodates diverse learning styles and preferences across genders. In addition, [6] reported that when multimedia-based instruction is effectively integrated into instructional delivery, it provides equal opportunities for engagement and understanding, without any gender bias.

Furthermore, the study revealed that no statistically significant interaction effect existed between Doodly-based instructional multimedia and gender on students' academic achievement. This implies that the effectiveness of Doodly-based multimedia instructions on academic achievement was not dependent on the students' gender. This finding aligns with the work of [18-20], which found no significant interaction effect between gender and multimedia instructions on students' academic achievement. Supportively, [21, 22] suggest that the interactive and adjustable nature of multimedia instructions helps reduce prejudice associated with gender and ensures uniform cognitive participation in instructional exercises [23]. Supportively asserted that Doodly-designed multimedia can capture and sustain the attention of the intended audience to communicate the intended message. The current study, therefore, clearly demonstrated that Doodly-based multimedia instructions effectively close gender gaps in learning and provides a balanced and inclusive instructional experience for undergraduate students with LDs.

5. CONCLUSION

This study provides strong empirical evidence that Doodly-based instructional multimedia can improve the academic achievement of undergraduate students with LDs in EdTech. This finding emphasizes alternative and supportive instructional strategies to help students with LDs better accommodate and perform in educational environments. The study explored the influence of gender as a possible defining factor in academic achievement. However, gender difference was not significant in the effect of Doodly-based instructional multimedia on undergraduate students with LDs in EdTech. This suggests that students with LDs had improved academic achievement, regardless of gender differences. Finally, it was statistically proven that there was no significant interaction effect between Doodly-based instructional multimedia and gender on the educational achievement of students with LDs in EdTech.

This study has contributed to the broader framework for diagnosing and treating intellectual disabilities by empirically demonstrating that Doodly-based instructional multimedia is a promising, gender-neutral intervention tool for enhancing the academic achievement of undergraduate students with learning disabilities in educational technology.

6. RECOMMENDATIONS

In line with the research findings, the researchers recommended thus:

i. Those responsible for making educational policies, as well as the management of higher education institutions, should motivate and promote the development and implementation of Doodly-based instructional multimedia for teaching students with LDs, for better learning outcomes.

ii. Policymakers and management of tertiary institutions should make adequate provision for workforce training in the design and implementation of Doodly-based instructions for the different kinds of learners, especially those with LDs.

iii. Policymakers and management of tertiary institutions should invest in necessary resources and infrastructure to facilitate the design, production and utilization of Doodly-based multimedia for effective instructional delivery among students with LDs.

iv. Limitations such as a small sample, institutional differences, and a lack of fidelity

checks may account for the limited generalizability of the study's findings.

v. The study considered learning disabilities holistically. Future studies should delve into specific types of learning disabilities (like dyscalculia, dysgraphia, dyslexia, and ADHD) to determine if Doodly-based multimedia instructions have varying degrees of effectiveness of each kind.

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The authors acknowledge the strict implementation of the ethics of research.

CONFLICTS OF INTEREST

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