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Effects of Doodly-Created Instructional Multimedia Environments on Academic Self-Efficacy of Undergraduate Educational Technology Students

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Abstract

Background: Research has established that multimedia instructions can positively impact students' general performance, but the effect it has on self-efficacy, especially using a tool like Doodly, is still not evident.

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Objective: The study explored the effect of environments of Doodly-created instructional multimedia on undergraduate educational technology students' self-efficacy, with the moderating role of gender.

Methodology: The 2x2 pre-test-post-test quasi-experimental factorial design was used to assess the study's three null hypotheses. A study sample of 196 students from the third year (92 males and 104 females) was selected through purposive and simple random sampling techniques. The data were collected using the Education Technology Self-Efficacy Questionnaire (ETSEQ). It was validated by experts and had Cronbach's Alpha reliability index of 0.96 before administering, marking, scoring and coding for analysis. Analysis of Co-Variance (ANCOVA) was used to test the hypotheses at a 0.05 level of significance.

Results: The results indicated a statistically significant positive effect of Doodly-created instructional multimedia on undergraduate students' self-efficacy in Educational Technology, irrespective of the learning environments (classroom or online). Gender did not significantly influence self-efficacy.

Conclusion: Seeing the outcome, the conclusion is that both environments of Doodly-created instructional multimedia increased undergraduate students' self-efficacy in Educational Technology without any influence of gender.

Unique Contribution: This study contributes to the existing body of knowledge by demonstrating the potency of Doodly-created instructional multimedia in significantly enhancing undergraduate students' self-efficacy in Educational Technology, irrespective of learning environment or gender.

Keywords*:* Effects, Doodly-created Instructional Multimedia, Environments, Academic Self-Efficacy, Undergraduate, Educational Technology, Students.

Introduction

The power of multimedia instruction on students' self-efficacy has been recognised as an important study area. Self-efficacy indicates a person's belief in his or her potentiality to accomplish a task and attain goals (Bandura, 1994), and it is also important in education because it affects students' motivation, persistence, and achievement (Schunk, 2022). When considering technology-enhanced learning environments across disciplines, students' determination to overcome learning challenges and effectively learn through digital tool skills is related to their self-efficacy about using such tools for solution strategies when faced with difficulties.

Digital tools have revolutionised teaching practices, and multimedia instruction has emerged as one of the most popular methods. Multimedia instruction, involving the presentation of visual and auditory materials, effectively enhances students' motivation and performance (Mayer, 2014). One tool underutilised in educational settings is Doodly, a digital animation software tool that allows educators to create interactive and visually stimulating multimedia (Woofresh, 2021). While the potential of this technology to improve student learning has been acknowledged (Johnson et al., 2024), there is insufficient research regarding its impact on self-efficacy.

Educational Technology is a pivot course in teacher preparation programs meant to expose would-be teachers to theoretical principles and practical skills for using technology to enhance teaching and learning (Lathan, 2021). However, despite its expected importance, classroom conditions of

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instruction, such as student-lecturer ratio and congested classrooms, among others evident in federal and state-owned universities, tend to constitute setbacks to effective instruction (Adelabu & Akinwumi, 2018). These conditions provide breeding grounds for ineffective transmission of contents, poor students' involvement/participation and underachievement, while students' self-efficacy in the subject diminishes.

To address this, technology has gained popularity among educational researchers investigating the challenges and opportunities of such use in Nigerian classrooms (Pedro et al., 2018; Johnson et al., 2021a). It is imperative to consider some influential factors to understand how Doodly-created instructional multimedia may relate to students' self-efficacy. The design principles of multimedia instruction, as posited by Mayer (2014), like coherence, modality and redundancy, could influence students' judgments of their capabilities. Moreover, the features of Doodly, such as animation and interactive sound effects, may enhance students' motivation and interest, thereby influencing self-efficacy positively (Johnson et al., 2021b).

Furthermore, the learning environment (classroom-based or online) may affect the relationship between Doodly-created instructional multimedia and self-efficacy. Classroom-based learning provides face-to-face interaction, immediate feedback, and a structured learning environment. On the other hand, online learning provides extensibility, self-paced instruction, and increased autonomy. Johnson et al. (2021a) have shown that online learning comes with unique challenges but could be productive when properly utilised. Doodly's interactive features may be advantageous, especially in boosting students' engagement in both environments.

Additionally, gender may also significantly influence access to, use of, and self-efficacy with technology. Gender differences in technology-related knowledge and confidence have been reported. For instance, females are often under-represented in science, technology, engineering, and mathematics (STEM) disciplines (UNESCO, 2019). Additionally, gendered preferences in learning styles can affect the instructional utilisation of technology (Zambon, 2020). An awareness of how Doodly-created multimedia materials interact with such gendered factors can help researchers and educators identify and address potential disparities and equity issues in education.

The potential for Doodly-created instructional multimedia to enhance students' self-efficacy is an exciting avenue for scientific research, building on the existing knowledge about multimedia learning, self-efficacy, and Educational Technology. This research, therefore, aims to investigate the self-efficacy of undergraduate educational technology students taught through Doodly-created instructional multimedia in classroom and online learning environments. At the same time, gender's mediating role is considered.

Literature Review

The following are reviewed as used in the context of this study:

Educational Technology

Educational technology is a dynamic field. It is not limited to hardware and software but also involves instructional design, development, implementation, management and evaluation. Educational technology is a multi-faceted concept that includes several related theories, reflection processes and practices. Some scholars see it as an art, while others label it as a science and a discipline. (Inyang-Abia, 2015). As an art, educational technology uses hardware and software tools, such as computers, projectors, interactive whiteboards, and the like, that help make teaching

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and learning more meaningful and fun. It also helps to create digital content, automate administrative tasks, analyse data, foster communication and collaboration, and support emerging applications like cloud computing for individualised learning and immersive reality experiences (Lynch, 2020).

Another important aspect of educational technology is that it empowers student engagement, collaboration, and knowledge retention by facilitating access to information and supporting the implementation of innovative learning experiences. For trainee teachers and educational professionals, Educational Technology is important because they must continuously learn new processes for implementing instructions and how to use those tools in their teaching practices for better instructional delivery (Lathan, 2021). Since Doodly can provide educational materials represented by a problem-solving approach for acquiring skills in building competency, this research focuses on identifying the impact of self-efficacy resulting from Doodly-created instructional multimedia on educational technology courses.

Doodly-created Instructional Multimedia

Doodly is a software tool that allows users to create compelling animations using a drag-and-drop interface. A designer can make whiteboard, blackboard, or even greenboard-style animations using Doodly's massive pre-drawn library of images (Woofresh, 2021). The word 'Doodly' comes from the concept of doodling, an activity that relaxes the part of the brain in charge of self-monitoring and increases mental activity (Cartoon Media, 2021). It uses elements like cartoons, pictures and text to illustrate concepts in animation, audio, and backgrounds, thus taking advantage of the brain's inclination to see a series of drawings as cohesive information.

Bryxen Company released Doodly in 2017. Currently, it is famous among marketers, YouTubers, and animators (Woofresh, 2021). Doodly's potential as an instructional tool is high because of its attention-capturing and retention-enhancing abilities. It can also help overcome the problems that adult learners face due to their low concentration in a distracting environment. The present research was designed to fill the knowledge gap on the effect of Doodly-created instructional multimedia on students' self-efficacy in Education Technology.

Classroom and Online Learning Environments

Traditional classroom teaching facilitates close interaction between the teacher and students in a physical space. Students can raise questions, seek clarifications, participate in discussions, watch demonstrations, and engage in real-world experiences. In contrast, online learning provides a flexible and convenient alternative to the traditional classroom (Online Education, 2016). It uses the internet to connect an instructor to students while employing different teaching methods (Pedro et al., 2018).

To enhance learning outcomes, educators must identify both learning environments' merits and limitations and find ways to maximise them. Technology provides mobile devices and interactive platforms that can benefit both types of education (Pedro et al., 2018). Studies comparing the effects of instructional multimedia, such as Doodly, in both education contexts, have been scarce.

Self-Efficacy in Educational Technology

Bandura (1994) defines self-efficacy as the belief in one's capacity to organise and execute a course of action needed to produce given levels of attainments. Academic self-efficacy refers to a student's confidence in performing academic tasks (Maddux & Klieman, 2022). Four kinds of

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information influence self-efficacy: mastery experiences, vicarious experiences (social modelling), verbal persuasion/ reassurance, and physiological/ affective states (Bandura, 1994). These sources of information influence our cognitive processes, motivation, affective/drive states, and selection processes, thereby influencing our thoughts, behaviour/behavioural patterns, and emotional reactions. High self-efficacy promotes more effective performance through increased efforts in time spent, more planning for future work, or greater overall persistence despite failures (Maddux & Klieman, 2022).

Educators should provide a supportive learning environment for mastery experiences, social interaction opportunities, support, feedback, and encouragement to enhance students' self-efficacy. Instructional multimedia such as Doodly that can foster those, as mentioned earlier, may improve students' self-efficacy. Hence, self-efficacy is a critical variable to be measured in this study.

Gender

In addition to looking at biological factors, researchers are increasingly considering the place of social and cultural influences in explaining why males and females differ in their learning, especially when multimedia is involved. Gender refers to the socially organised roles, behaviours, and norms assigned to males and females (Zambon, 2020). More recently, there have been suggestions that our traditional view of gender as binary may not be accurate for all people, which is where the idea of gender identity comes in. Gender identity refers to how an individual experiences their gender. For some people, it may align with their biological sex, while for others, it may differ completely (Nduagbo, 2020).

Given the ambiguous and controversial nature of gender itself, the researchers use the conventional and pragmatic male-female categorization in this study to investigate whether or not gender plays a role in students' self-efficacy when learning with Doodly-created instructional multimedia in the classroom and online settings.

Theoretical Framework

Connectivism, Siemens (2004)

Connectivism asserts that knowledge resides within systems and that learning happens via connecting nodes or information sources (Siemens, 2004). It is a theoretical departure from earlier learning theories because it focuses on technology's influence on learning and the changing nature of knowledge in today's interconnected society. Core principles of connectivism, autonomy, connectedness, diversity, and openness frame learning as a process of engaging with and making decisions within self-organising systems (Vehagen, 2006).

Doodly is a powerful instrument that can improve the learning experience by applying connectivist principles. As a web tool for creating animated motion pictures, Doodly helps create vital connections between learner, instructor, and subject content and enriches and personalises the learning process. By exploring how to apply Doodly in teaching and learning to construct a connected and engaged learning ecology, this research tends to extend our understanding of using instructional technology to foster students' successful learning and enhanced self-efficacy.

Self-Efficacy Theory

Albert Bandura's self-efficacy theory holds that a person's belief in his capability to perform tasks successfully is essential in his behaviour and motivation (Bandura, 1994). This construct, which often shows greater association with behaviour than outcome expectancies, is developed based on

DOI: https://doi.org/10.5281/zenodo.13895408 EISSN: 2735-9891

experiences of mastery, vicarious learning, verbal persuasion and physiological states (Maddux & Klieman, 2022). Central to the current investigation is how Doodly-created instructional multimedia may foster students' self-efficacy, as students are presented with instructional content utilising engaging audio and visual imagery.

Furthermore, although this study does not directly manipulate the physiological state, the researchers expect that, in general, Doodly-created instructional multimedia could affect students' confidence and motivation and impact their emotional responses to challenges, affecting their self-efficacy.

Development and Implementation of Doodly-created Instructional Multimedia Intervention
The development, delivery, and evaluation of Doodly-created instructional multimedia were guided by the ADDIE model, which was developed by the Centre for Educational Technology, Florida State University (1975). The model is comprised of analysis, design, development, implementation, and evaluation phases.

The analysis involved a deep understanding of learners, content, environment, and instructors. A pre-study was undertaken using the Topic Difficulty Inventory to identify four core topics in Educational Technology that needed to be addressed. The researchers and lecturers involved in the study were trained on how to use Doodly for instructional design and utilisation to ensure they had the needed proficiency.

The Design phase consisted of determining instructional objectives, designing a storyboard, and developing plans for implementation and evaluation. The blueprint of the storyboard described components such as content, visuals, audio, and evaluations that would be used in experiments.

The development of Doodly-created instructional multimedia included the production of audiovisual material based on the storyboard. The text was transformed into audio, and visual materials were selected on the Doodly timeline to represent the narration using Doodly software. Expert references and reviews were done to develop and improve each component further to the required standard.

On implementation, trail testing was first conducted to determine the viability of the developed materials. Thereafter, the lesson materials were administered to a classroom group and an online group. The classroom group received face-to-face instruction using a multimedia projector, whereas the online group received its lesson materials via WhatsApp.

The evaluation included the pre-test and post-test data collected to determine the effect of Doodly-created instructional multimedia on students' self-efficacy in Educational Technology and to inform the effectiveness of the instructional approach.

Research Hypotheses.
Three research hypotheses were put forward for scientific testing, thus:

Ho1: There is no statistically significant difference in the mean self-efficacy scores of classroom and online students taught Educational Technology with Doodly-created instructional multimedia.

Ho2: There is no statistically significant difference in the mean self-efficacy scores of male and female students taught Educational Technology with Doodly-created instructional multimedia.

DOI: https://doi.org/10.5281/zenodo.13895408 EISSN: 2735-9891

Ho3: There is no statistically significant interaction effect of environments of Doodly-created instructional multimedia and gender on the mean self-efficacy scores of students in Educational Technology.

Research Method

A 2x2 pre-test, post-test quasi-experimental factorial design was used for the study. Using purposive and simple random sampling techniques, a sample of 196 third-year undergraduate students (92 males, 104 females) was drawn from the Faculty of Education at the University of Calabar and the University of Cross River State. The third year was selected because educational technology is a core course at this level. The four specific areas covered by the Doodly designed instructional multimedia; Forms of Educational Technology, Components of Educational Technology, Information and Communication Technology and Principles of Effective Improvisation, used for the treatment experimentation were determined through a pilot survey conducted as topics considered difficult by students in an educational technology course.

For classroom and online conditions, a coin-toss randomisation was performed where a representative from the group chose one side of the coin, and based on the result, the condition was assigned. The instrument for data collection was the Educational Technology Self-Efficacy Questionnaire (ETSEQ), adapted from the University of Kansas Center for Research on Learning (2015). It had two sections; "A" – requesting respondents' personal information, and "B" - containing 20 items, using the modified Likert's four-point rating scale, with options of Strongly Agreed (SA – 4 points), Agreed (A-3points), Disagreed (D-2points), and Strongly Disagreed (SD-1point). The instrument was validated by 3 Educational Technology, 2 Educational Psychology and 2 Tests and Measurements experts. The Cronbach's Alpha reliability of the ETSEQ was 0.96, validating its use for data collection (Wainer, 2014). The instrument was administered as a pre-test before and post-test (with rearranged items) after the treatment. Data was sorted, marked, scored, coded, and analysed using IBM SPSS Statistics 23. ANCOVA was employed to test all hypotheses at the 0.05 significance level.

Test of Normality

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 Self-Efficacy	Classroom Instructio Mode	.103	105	.008	.952	105	.001
	Online Doodly Instructional Env.	.097	91	.036	.976	91	.035
Post-test Edu Tech Self-efficacy	Classroom Instructio Mode	.110	105	.003	.931	105	.000
	Online Doodly Instructional Env.	.078	91	.040*	.971	91	.039

DOI: https://doi.org/10.5281/zenodo.13895408 EISSN: 2735-9891

The data in Table 1 show the Shapiro-Wilk test of normality of the data sets. Since the probability (Sig.) values are all less than 0.05, by which the results were tested, this implies that the data is normally distributed and hence suitable for ANCOVA to be used in testing the hypotheses at the 0.05 level of significance (Wainer, 2014).

Study Results

The results of the study are presented below:

H01: No statistically significant difference exists in the mean self-efficacy scores of classroom and online students taught Educational Technology with Doodly-created instructional multimedia.

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

Source	Type III Sum of Square	Df	Mean Squ	F	Sig.	Partial Eta Squared (η^2_p)	Dec.
Corrected Model	494.654[a]	4	123.664	1.706	.150	.034	
Intercept	20368.064	1	20368.064	280.988	.000	.595	
Pretest EduTechSelf-Efficacy	346.514	1	346.514	4.780	.030	.024	
Group	30.621	1	30.621	.422	.517	.002	NS
Gender	102.510	1	102.510	1.414	.236	.007	NS
Group * Gender	2.995	1	2.995	.041	.839	.000	NS
Error	13845.075	191	72.487				
Total	901031.000	196					
Corrected Total	14339.730	195					

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

Table 2 indicates no statistically significant difference between mean self-efficacy scores of classroom and online students exposed to Doodly-created instructional multimedia in Educational Technology ($F(1, 191) = .422$, $p = .517$, $\eta^2p = .002$). The negligible effect size ($\eta^2p = .002$) strengthens this finding; thus, the null hypothesis is retained as classroom and online environments of Doodly-created instructional multimedia were similarly effective in improving students' self-efficacy in Educational Technology.

H02: There is no statistically significant difference in the Mean self-efficacy scores of male and female students taught Educational Technology with Doodly-created multimedia instruction.

Table 2 results also show that there is no significant difference in the mean self-efficacy scores about the gender variable among the students who studied Educational Technology ($F(1, 191) = 1.414$, $p = .236$, $\eta^2p = .007$). Since the p-value .236 is higher than $\alpha = = .05$, it can be said that gender does not significantly affect students' self-efficacy about Educational Technology. Consequently, the inference

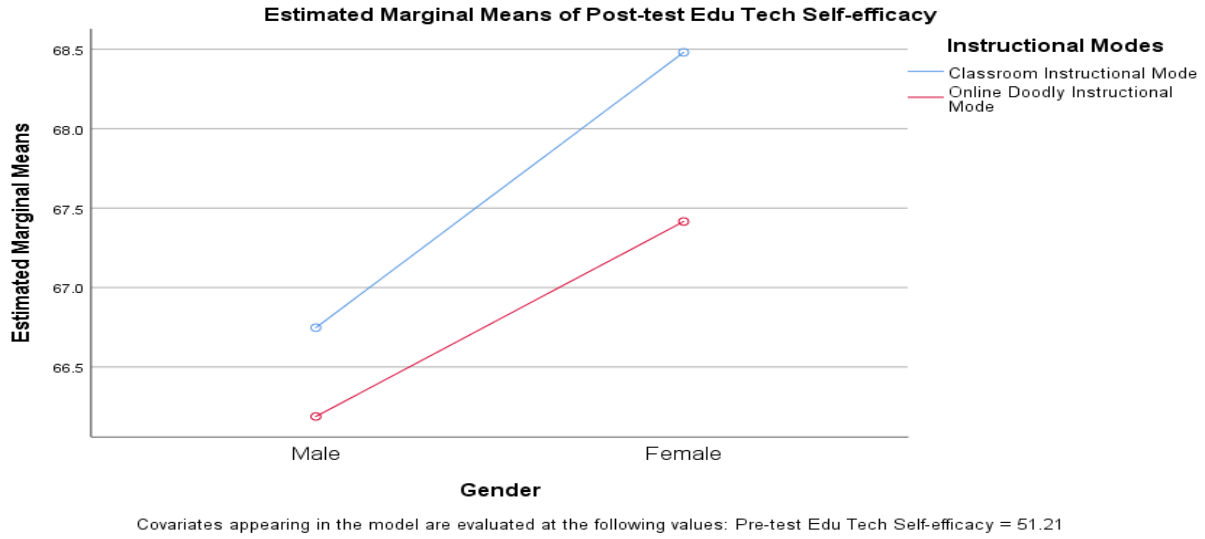
DOI: https://doi.org/10.5281/zenodo.13895408 EISSN: 2735-9891

is that there is no significant difference in the mean self-efficacy scores of male and female students in Educational Technology.

H0$_3$: There is no statistically significant interaction effect of environments of Doodly-created instructional multimedia and gender on the mean self-efficacy scores of students in Educational Technology.

Table 2 results further revealed that there is no significant interaction effect among environments of Doodly-created instructional multimedia and gender on students' mean self-efficacy scores in Educational Technology ($F(1, 191) = .041$, $p = .839$, $\eta^2p = .000$). The p-value of .839 is greater than the level of significance at .05; thus, upholding the null hypothesis. Furthermore, the effect size difference ($\eta^2p = .000$) reiterates this outcome. Hence, the inference drawn is that the interaction effect of environments of Doodly-created instructional multimedia and gender on the Mean self-efficacy scores of students in educational technology is not statistically significant. In the graph of interaction, as shown below, lines are not crossing each other, which also indicates no interaction effect:

Figure one (1): Profile plot for interaction effects of environments of Doodly instructional multimedia and gender on the mean self-efficacy score of students in Educational Technology.



The profile plot in Figure 1 presents evidence of the absence of a significant interaction effect between environments of Doodly-created instructional multimedia and gender on students' mean self-efficacy scores in Educational Technology. The straight lines representing the two levels of the Doodly-created instructional multimedia environments and gender on the graph are approximately parallel and show no crossing, indicating the absence of an interaction effect on mean self-efficacy scores of undergraduate educational technology students. The marginal means of classroom environment (67.72) and online environment (66.67) were equal for both males and females, thereby suggesting the absence of a possible significant interaction effect.

Discussion of Findings

The study shows that Doodly-created instructional multimedia helps to boost the self-efficacy of undergraduate students studying Educational Technology. Interestingly, the analysis found that there was not any significant difference in the mean self-efficacy scores between the classroom and online

DOI: https://doi.org/10.5281/zenodo.13895408 EISSN: 2735-9891

groups of students. This might be because Doodly's unique design helps both groups learn effectively, making them more confident. This is in line with what Okereke (2019) and Gongden et al. (2020) discovered: using audio-visual media can strengthen a student's confidence and boost their self-efficacy. According to Bandura (1994), self-efficacy can grow from positive experiences and mastering new skills. So, by using Doodly-created multimedia, students might have been better able to pay attention and understand important messages. This could have led to a real boost in their academic self-efficacy in Educational Technology. The findings here agree with Bandura's theory.

Additionally, the study found that both genders' self-efficacy improved evenly after engaging with Doodly-created instructional multimedia. This suggests that gender did not play a role in these results. It seems like Doodly's special features bridge the gender gap, allowing all learners to gain confidence equally. Kassaw and Astalke (2017), along with Nkanu et al. (2024) and Johnson et al. (2024), found something similar: students across both genders scored high on self-efficacy when they used multimedia packages.

This study further highlights that improving self-efficacy in students is mainly due to how effective and efficient Doodly-created instructional multimedia is, and not about gender. That's why there was no statistically significant interaction effect between gender and the environments of Doodly-created instructional multimedia in the self-efficacy scores. Doodly-created instructional multimedia can catch attention and communicate essential messages without worrying about gender differences. This finding backs up what Adene and Umeano (2020) and Shotayo and Olushola (2022) found: gender does not change how effective instructional multimedia is in boosting students' self-efficacy.

This implies that using the right multimedia, like Doodly, can truly grab students' attention while sending clear instructional messages. Teachers who understand how to effectively create, develop, and use Doodly instructional multimedia can help students overcome learning challenges.

Conclusion and Recommendations

The study results showed no significant differences between classroom and online environments on undergraduate students' self-efficacy scores in Educational Technology, both of which used Doodly-created instructional multimedia. In addition, the findings revealed that gender does not significantly affect undergraduate educational technology students' self-efficacy, and there were no statistically significant interaction effects between learning environments of Doodly-created instructional multimedia and gender. Based on these results, the following recommendations are proposed:

i. Educational institutions are urged to promote the utilisation of Doodly-created instructional multimedia in teaching for better outcomes.
ii. Faculties management should provide opportunities to develop expertise in designing and implementing Doodly-created instructions for diverse students.
iii. Policymakers and universities should invest in the necessary infrastructure and resources to facilitate the effective integration of Doodly into teaching and learning practices.

Suggestions for Further Studies

Researchers should further investigate the use of Doodly-created instructional multimedia to extend the findings and better understand the relationship between Doodly-created instructional multimedia, deep learning approach, student self-efficacy and academic performance across different disciplines.

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