DIGITAL CLASSROOM INNOVATIONS: LEVERAGING SMARTPHONE-BASED APPLICATION TO STIMULATE STUDENTS CREATIVE THINKING SKILLS

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ABSTRACT

Enhancing 21st-century skills, such as creative thinking, is crucial and can be stimulated by integrating Information and Communication Technology (ICT) in the learning process. Therefore, this research aims to evaluate the effectiveness of an Articulate-based mobile application in helping students improve their creative thinking skills. The quantitative research method uses quasi-experimental models and a one-group pre-post-test design. The research involved 60 students as subjects, divided equally into two groups: the experimental and control groups. The research data was collected through tests of creative thinking skills conducted before and after implementing the smartphone-based application. Data analysis is conducted using the t-test technique to compare the test results before and after the intervention and N-Gain to measure the improvement of creative thinking skills. The research results indicate that implementing application media has proven effective and significantly improves students' creative thinking skills. The implications of this research can be used as a reference for the development of technology-integrated education. Moreover, this research contributes to providing elaboration regarding the role of smartphone-based applications as one of the efforts to enhance students' creative thinking skills in the era of digital education.

KEYWORDS

Applications, articulate, creative thinking skills, digital, smartphones

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Highlights

- *Articulate-based learning media significantly enhances students' creative thinking skills in graphic design education.*
- *A positive relationship between the use of mobile learning media and improvements in students' creativity was observed.*
- *The study indicates that Articulate-based media offers an effective approach to fostering creativity in vocational education settings.*
- *The findings support the integration of digital learning tools to improve creative abilities and engagement among vocational school students.*

INTRODUCTION

The Immense development of science and technology in the 21st century has reached almost all sectors, including the economic, socio-cultural, and education fields (Bunyamin, Samsudi and Rohman, 2022). The education field plays a critical role due to its function: preparing Indonesia's future generations (Hussin, 2018). The education sector is crucial as it is responsible for establishing Indonesia's future workforce and leaders (Dunn and Kennedy, 2019). Therefore, optimizing and improving the quality of the educational process is a necessity that must be addressed. The young generations need to get a high-quality education, not only in school but also in the transition process of entering the professional field (Putra et al., 2023). The quality of education is closely related to an effective learning experience. The interaction between teachers and students in the learning process is crucial to achieving the desired learning outcomes (Zainal et al., 2018).

Rapid adaptation has become a necessity amid the rapid developments in technology and information. The ability to access, manage, and utilize information and technology wisely is essential (Yeşilyurt and Vezne, 2023) digital literacy (DL). This requires systematic, logical, and critical thinking skills,

which can be developed by improving education quality. In this context, teachers play a crucial role, particularly in enhancing their teaching methods through the integration of Information and Communication Technology (ICT) tools to create diverse learning materials that address challenges encountered during the learning activities (Misir, 2018; Yılmaz, 2021). With the large variety of learning media availability, the learning process will become more interesting for students. Therefore, improving students' soft skills will accelerate learning goal achievement.

Vocational schools are crucial in equipping students with practical skills and relevant knowledge in the creative industry, particularly in graphic design. This specialized learning at Vocational High Schools (SMK) forms an integral part of the curriculum, ensuring that students are well-prepared for the demands of the industry (Liow, Palilingan and Komansilan, 2022). Throughout this educational experience, students will gain exposure to essential graphic design ideas, which encompass the application of design programs like Adobe Photoshop, Illustrator, and InDesign (Qomariyah, Kuswandi and Praherdhiono, 2019). Students learn about the principles of design, visual composition, typography, image manipulation, and the production of graphic materials. Learning graphic design at vocational schools also often involves practical projects that challenge creativity and problem-solving skills, such as creating posters, brochures, logos, and graphic designs for digital media (Chetty et al., 2019; Giana and Lutfi, 2019). Subsequently, students can enhance their portfolio as they engage in this task, thereby creating a valuable asset for future endeavors in the workforce or further studies in graphic design or related creative fields (Sudana, Apriyani and Nurmasitah, 2019). It is important to understand that by adopting a practical and industry-oriented approach, vocational schools that offer graphic design programs for students should provide not only theoretical understanding but also the practical skills essential for thriving in the professional realm of graphic design (Puruwita, Jamian, and Aziz, 2022). Hence, in the realm of graphic design education, instructors frequently assign projects that require the utilization of creative and interactive learning techniques. By doing so, students can attain the best possible results in their graphic design studies.

During observations in graphic design learning, it was noted that there is limited variation in the use of learning media. Despite implementing inclusive teaching methods and strategies, such as project-based learning, the media tends to be restricted. Most instructional materials are delivered through conventional PowerPoint presentations and other printed media. This can lead to a monotonous and less engaging learning process for some students with diverse learning preferences. However, it is essential to recognize that learning graphic design necessitates creative thinking and ideation to meet user needs effectively. Therefore, concerted efforts should be made to diversify the range of learning materials used. This will give students greater stimuli for creativity and idea generation in graphic design. These observations underscore the importance of integrated and comprehensive media to enhance learning. A thorough understanding of the subject contributes to meaningful learning experiences, and diverse media can catalyze positive learning outcomes (Fletcher et al., 2020).

Regarding the factors contributing to the limited variation in the use of digital learning media, one possible cause could be the preference of some teachers for print-based materials due to fewer distractions during the learning process. This distraction can be mitigated by disabling notifications on unnecessary applications when using technology for learning. Therefore, there is a need for digital learning media that can help students generate creative ideas to fulfill graphic design project assignments. This study aims to assess the effectiveness of digital learning tools in the form of an Articulate-based application that can be used in smartphones to enhance creative thinking skills in graphic design subjects among vocational high school students.

LITERATURE REVIEW

Theoretical Foundations and Concepts of Digital Learning Media

The application of media in learning serves its purpose by facilitating students' comprehension of diverse lesson information that might be challenging to grasp solely through lectures. This phenomenon is undoubtedly intertwined with the development and emergence of both applied research and theoretical models related to educational technology, which have led to significant changes within the educational environment (Kazu and Yalçin, 2022). The creation of learning media necessitates careful consideration of the material's characteristics and the requirements of students and colleagues to ensure its suitability for meeting the student's needs (Budiastuti, Khairuddin and Azman, 2018). An instance of educational technology in progress involves the creation of a learning tool accessible through students' smartphones, utilizing the Articulate Storyline platform. This digital resource integrates textual content, video guides, and real-life examples to deliver information in an organized fashion, enhancing comprehension for students (Viberg, Grönlund and Andersson, 2020). This digital learning tool has been proven to positively impact student academic achievement and has been widely used in various learning contexts (Fletcher et al., 2020; Firdawati, Maison and Nazarudin, 2021). This application will focus on learning graphic design and presenting various materials and tutorials to stimulate students' creative thinking abilities. The primary purpose of using this application is to encourage students to think more creatively in designing graphics for the projects given to them (Triyono, Muhtadi and Widowati, 2022; Pujawan, 2019). For example, a study by Suharno, Selviana, and Sunarno (2022) demonstrated a significant increase in students' creative thinking skills through digital learning media. This was reflected in the data from the pre-test and post-test scores. The average pre-test score was 62, which increased to 84 in the post-test. The N-gain value for creative thinking was calculated at 0.59, indicating a moderate increase in students' creative thinking skills in various aspects such as fluency, flexibility, originality, elaboration, and evaluation. Therefore, the implementation of digital learning media, such as the Articulate Storyline application, not only enriches

the learning experience but also contributes significantly to enhancing students' creative thinking abilities, which is crucial in graphic design education. Integrating technology in learning can yield extensive positive impacts in terms of academic achievement and the development of 21st-century skills such as creativity.

Impact of Digital Learning Media on Student Performance and Motivation

Media-assisted learning can simplify abstract concepts, making them more understandable, accessible, and attainable for learners. Teachers often face challenges in creating high-quality learning materials, but the availability of media enables them to effectively structure and customize diverse learning approaches (Ismail and Al Allaq, 2019). As with several research studies on the effectiveness of digital media conducted by Heliawati, Lidiawati, and Pursitasari (2022), the study evaluated the impact of Gamification-based Articulate Storyline 3 multimedia on students' critical thinking skills and self-regulated learning. It involved 64 students and eight science teachers, focusing on the properties of acidic, alkaline, and neutral solutions. The results showed a significant improvement, with an average score of 81.50 for critical thinking skills and an N-Gain of 72% in the high category. Additionally, students demonstrated strong independent learning, with an average of 86.76% in the good category, indicating the multimedia's effectiveness in enhancing critical thinking and self-regulation. In line with research conducted by Kusuma, Suryani, and Sumaryati (2022), the research indicates that digital learning media accessible via smartphones significantly boosts students' motivation during class participation. The statistical analysis reveals a noteworthy increase in motivation within the experimental group, which achieved an average score of 86.6 compared to the control group's 75.9. This finding underscores the effectiveness of mobile application-based learning media in enhancing student motivation, surpassing traditional, non-digital methods.

Moreover, using digital learning media can also enhance students' vocational skills in vocational schools. This is expressed by Hartanto et al. (2022). Application development that validators have approved is apparently capable of providing vocational school graduates with increased job skills. Additionally, digital learning media integration can be merged with inventive learning methodologies, like case-based learning or problem-based learning (Heliawati, Lidiawati and Pursitasari, 2022; Daryanes et al., 2023). Therefore, teachers do not need to worry if the use of digital media later hinders their implemented learning strategies.

Various formats of digital learning media that can be accessed through smartphones have been identified through an analysis of several research studies. These formats include multimedia, e-modules, applications, and virtual labs. Using digital learning media on smartphones offers many possibilities (Sindu et al., 2020; Nusir et al., 2013; Dewi et al., 2022). Many studies have stated that digital learning media can help students complete assignments and acquire 21st-century skills (Hadiyanti et al., 2021; Damopolii, Lumembang and İlhan, 2021). This study seeks to bridge the literature gap by exploring the use of mobile applications with tutorial learning videos in vocational schools, particularly in graphic design education. While digital learning tools are widely used across various subjects, science materials still dominate the field.

MATERIALS AND METHOD

Research Design and Participants

This research employed a quantitative, pre-experimental design using a One Group Pretest-Posttest (Maisarah, 2019). This design is commonly utilized in preliminary studies where the objective is to observe changes before and after an intervention within the same group. While valuable in exploring potential outcomes, pre-experimental research is often considered a less robust form of experimental research due to the lack of a control group and the possible influence of external variables that may impact the results (Kartowagiran et al., 2017). To mitigate these limitations, careful consideration was given to controlling external factors. For example, the sample was selected using a cluster sampling technique to ensure the accuracy and reliability of the data.

The sample in this research was selected using a cluster sampling technique (Sutrisni et al., 2022). This technique was chosen because it allows for the efficient collection of data from a smaller yet still representative within a larger population. The study's population comprised vocational high school students in Surakarta, Indonesia. The sample included 60 students, with 30 students assigned to the experimental class and 30 to the control class. The age range of the participants was between 16 and 18 years, with both male and female students included, ensuring a balanced gender representation. This sampling technique made data collection more manageable and ensured that the sample accurately reflected the broader student population's characteristics, thereby enhancing the generalizability of the research findings.

Data Collection Instruments and Techniques

The One Group Pretest-Posttest design employed in this study provided a structured method for assessing changes in students' creative thinking skills within a single class (Yaniawati et al., 2023) Design, Develop, Implement, and Evaluate (ADDIE. The process began with administering a pre-test to evaluate the student's initial proficiency in graphic design content, serving as a baseline for comparison. The pre-test scores were then aggregated to determine the average performance of the class, which provided a clear starting point for the intervention.

Following the pre-test, teachers were instructed to deliver the graphic design course using an instructional media application called Articulate, specifically developed for this study. This application was designed to be the primary learning resource for students, featuring embedded probing and prompting questions to stimulate creative thinking. The instructional media was implemented over three sessions, each lasting 45 minutes, totaling six lesson hours. This structured approach ensured consistent exposure to the material across all participants.

After completing the instructional sessions, a post-test was administered to evaluate any improvements in students'

creative thinking skills. The post-test results were compared with the pre-test scores to identify differences in learning outcomes, specifically focusing on creativity skills. This study employed a One Group Pretest-Posttest design to assess the impact of Articulate-based instructional media on students' creative thinking abilities. Initially, students took a pre-test (*O*1) to establish a baseline of their creative thinking skills before being exposed to the Articulate-based media. The instructional media, tailored specifically for the graphic design subject, was then implemented as the treatment (*X*). After completing the learning process using this innovative media, students took a post-test (*O*2) to measure improvements in their creative thinking abilities. This design effectively captures the progression of students' learning, providing a clear and engaging view of how using Articulate-based media can enhance their creative skills.

The data collection method employed in this research involved distributing questionnaires to students (Maisarah, 2019). The questions provided were on a 1 to 5 scale, aiming to gather information about students' creativity. The questionnaire consisted of 20 questions or statements, drawing inspiration from previous studies conducted by Pratomo, Siswandari, and Wardani (2021) and Dewanti (2022) regarding students' creativity as a copy of the questionnaire can be found in Appendix A for reference. Table 1 summarizes the grid used to measure students' creativity levels.

No	Component	Indicator	Item
1.	Fluency	Ability to generate lots of ideas	5
2.	Flexibility	Ability to generate ideas that are different from the common ones	4
3.	Originality	Ability to generate new and original ideas	4
4.	Elaboration	Ability to develop ideas in detail	4
5.	Evaluation	Ability to assess ideas and choose the best	3

Table 1: Instrument Grid for Assessing Creative Thinking Skills (adapt from: Pratomo et al., 2021; Dewanti, 2022)

Data Analysis Technique

The data analysis process in this study involved several essential steps to ensure the validity and reliability of the findings. Initially, data on learning outcomes were gathered through pre-tests and post-tests, administered before and after implementing the instructional media products. To ensure accurate analysis, the collected data underwent prerequisite tests, including tests for normality and homogeneity. The *Shapiro-Wilk* test, particularly suitable for small sample sizes, was used to assess normality, as it provides more precise results in determining whether the data distribution is normal. In this study, data is considered normally distributed if the *Shapiro-Wilk* test yields a *p*-value greater than 0.05 ($p > 0.05$) (Irawati, Huda and Adji, 2022). Additionally, the homogeneity of variance between the pre-test and post-test groups was examined using a homogeneity test, where data is considered homogeneous if the significance value exceeds 0.05. If the significance value is significant ($p < 0.05$), it would indicate that the data variances are not homogeneous (Maharani Zan and Mardian, 2022).

Upon confirming that the data met the prerequisites, further analysis was conducted using the paired sample *t*-test. This statistical method was chosen to determine whether there is a statistically significant difference in learning outcomes before and after using Articulate-based instructional media. Meanwhile, the research hypothesis is as follows:

H_0: There is no difference in learning outcomes before and after using instructional media based on Articulate.

H_1: There is a difference in learning outcomes before and after using instructional media based on Articulate.

To further assess the instructional media's impact or effectiveness, an N-Gain test was conducted. This test measures the magnitude of improvement in learning outcomes by comparing the pre-test and post-test scores, offering a clear quantification of the instructional media's effectiveness. The formula for N-Gain analysis is provided below.

$$\text{N-Gain} = \frac{T_{\text{post}} - T_{\text{pre}}}{T_{\text{max}} - T_{\text{pre}}}$$

Based on the results of the N-Gain analysis, the effectiveness of the instructional media was categorized into three levels: High ($g \geq 0.700$), Moderate ($0.300 < g < 0.700$), and Low ($g < 0.300$) (Nasir and Nirfayanti, 2020). Table 2 illustrates the classification criteria for interpreting the N-Gain scores, providing a clear framework for understanding the impact of the instructional media on student learning outcomes.

N-Gain Score	Category
$g < 0.700$	High
$0.300 \leq g \leq 0.700$	Moderate
$g < 0.300$	Low

Table 2: N-Gain Score Categories for Creative Thinking Skills (adapt from: Nasir and Nirfayanti, 2020)

RESULTS

In evaluating the effectiveness of the Articulate-based learning application, students participated in three face-to-face class meetings focused on graphic design. This application served as a learning tool and resource throughout the process. Before using the application in class, students completed a pre-test questionnaire designed to assess their initial level of creativity. The teacher incorporates this media into the learning activities implemented thus far. Throughout the learning process, the teacher employs project-based learning, wherein students are typically required to submit project assignments related to the material or topics on graphic design during the 4th

meeting. From this, it can be inferred that the utilization of this medium is not immediate during the learning process. Instead, the teacher first studies it to establish connections with the learning strategies employed.

When the learning material had been delivered to students for three meetings, students filled out the questionnaire containing the same post-test questions/statements as the pre-test. This questionnaire also has the same aim: to see whether there is a difference in students' initial and final creative abilities after three meetings using media. Articulate-based learning. The following is a description and analysis of the questionnaire score obtained.

Normality and Homogeneity Test Results

In order to ensure the homogeneity of the data in the one-group pre-/post-test design, statistical evidence must be provided that the variance used in this research is truly homogeneous. Hence, the homogeneity test results presented in Table 3 are one of the prerequisite tests that must be fulfilled.

		Levene Statistic	*df*1	*df*2	*Sig.*
Creativity Skills	Based on Mean	3.211	1	58.000	0.078
	Based on Median	2.772	1	58.000	0.101
	Based on the median and with adjusted df	2.772	1	46.066	0.103
	Based on trimmed mean	2.295	1	58.000	0.135

Table 3: Results of the Homogeneity Test (source: Data processed by SPSS (2024))

Based on the test results output with the help of the SPSS application, the *Sig* value is known. Based on the mean for student creativity ability score is 0.078. Because of the *Sig* value 0.078 > 0.05, it can be concluded that the student data variance is homogeneous. One of the prerequisite tests has been successfully fulfilled. The next is the normality test. Data normality test is applied to see whether the data from research results is normally distributed. This test uses the *Shapiro-Wilks* Normality test technique; the selection of this technique is based on the number of samples which tends to be small (< 150). The results of the data normality test are presented in Table 4.

Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	*df*	*Sig.*
Creativity Skills	Pre Test	0.131	30	0.199	0.973	30	0.638
	Post Test	0.160	30	0.047	0.932	30	0.055

a. Lilliefors Significance Correction

Table 4: Results of the Normality Test (source: Data processed by SPSS (2024))

According to the statistical results obtained using the SPSS application, the *Sig* is evident. value for the pre-test score is 0.638, while the *Sig*. value for the post-test score is 0.055. In both cases, the *Sig*. values are greater than 0.05. Therefore, similar to the decision-making process in the *Shapiro-Wilk* Normality test, it can be inferred that the data for both the pre-test and post-test scores follow a normal distribution. Although the *Sig*. (*p*-value) for the post-test is 0.055, which is close to the significant threshold of 0.05, the data can still be considered to meet the normality assumption based on several considerations. In social and educational research, a p-value near 0.05 is often regarded as "marginally non-significant," implying that although it is close to the threshold, the data is not entirely non-normal. Furthermore, the *Sig.* value for the pre-test (0.638) indicates a normal distribution. Therefore, the overall normality test results can be viewed within a broader context, and the post-test data can still be treated as normal for further analysis, including paired *t*-tests. However, the interpretation of the results should be done with caution. Based on this analysis, the fulfillment of both prerequisite tests suggests that a paired *t*-test can be conducted to assess the impact of media use on enhancing students' creative thinking skills.

Test Results of the Influence of Smartphone-Based Application Media

Testing the impact of Smartphone-Based Application media products on students' creative abilities during learning activities was done using the paired sample *t*-test technique. Table 5 and Figure 1 describe the results of the statistical test analysis, which shows that, on average, the analysis shows a significant difference between pre-test and post-test scores; it was identified that there is a difference in the average score of the pre-test and post-test, where the pre-test score obtained an average of 50.80 and the post-test score obtained an average of 84.83. As illustrated in Figure 1, there is a clear upward trend in the creative thinking scores of students, particularly after the second session of the intervention. This indicates an increase in the average score of students' creative abilities after using Articulate-based media.

		Mean	*N*	Std. Deviation	Std. Error Mean
Pair 1	Pre_Test	50.80	30	3.585	0.655
	Post_Test	84.83	30	3.505	0.640

Table 5: Descriptive Statistics of Pre-Test and Post-Test Scores (source: Data processed by SPSS (2024))

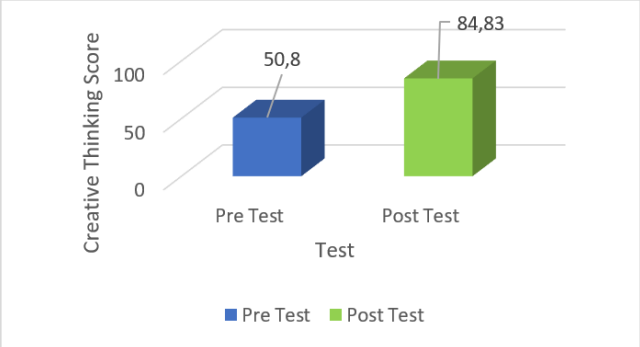

Figure 1: Average Pre-Post Test Score

In the context of conducting significance-level testing through the paired sample t-test, the findings presented in Table 6 indicate that the *Sig*. (2-tailed) value is < .000, less than the predetermined significance level of 0.05. Consequently, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. Therefore, it can be inferred that there exists a disparity between the average scores of the Creativity Skills pre-test and post-test. This discrepancy suggests that the utilization of articulate-based learning media has a positive impact on enhancing the creative abilities of vocational school students.

	Paired Differences					*t*	*df*	*Sig.* (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre_Test - Post_Test	-34.033	5.798	1.059	-36.198	-31.868	-32.149	29	0.000

Table 6: Paired Sample *T*-Test Results (source: Data processed by SPSS (2024))

The N-Gain test assessed the impact of changes in students' creative skills. Specifically, it was utilized to gauge the effectiveness of Articulate-based learning materials in graphic design education. By comparing students' pre-test and post-test scores, the N-Gain test determines whether there has been a noticeable improvement in their creative abilities following exposure to the instructional media. The tabulated outcomes of the student N-Gain analysis are detailed in Table 7.

Indicator Aspect	Test	
	Pre Test	Post Test
Samples	30	30
Highest Score	56	90
Lowest Score	44	78
Average N-Gain	0.680	

Table 7: N-Gain Scores for Students' Creativity Abilities (source: Data processed by SPSS (2024))

Upon conducting an analysis using N-Gain, the findings from a research study investigating the utilization of Articulate-based media indicate that the average N-Gain Score attained a value of **0.68**, positioning it within the Moderate range (0.3 < **0.68** < 0.7). This outcome signifies that the implementation of this media has a noteworthy influence on enhancing the creative aptitude of students enrolled in Vocational High Schools (SMK). Consequently, it can be inferred that Articulate-based media is efficacious in augmenting the creative capabilities of vocational school students and holds promise as an effective educational tool within the vocational school setting.

DISCUSSIONS

The Influence of Digital Learning Media on Student Creativity

Discussing the methodology elaborated earlier, this research provides empirical evidence demonstrating the positive influence of digital learning media on students' creative abilities. The increase in creativity abilities in the post-test was higher than in the pre-test, which was based on the statistical analysis results of the *Sig*. (2-tailed) is 0.000 < 0.05, so H_0 is rejected and H_1 is accepted. So, there is a difference in the average Creativity Skills pre-test and post-test. The existence of this digital learning media can provide more optimal stimulus and train students to think as creatively as possible in completing tasks in graphic design learning. The choice of Articulate as the instructional media was driven by its flexibility and capacity to engage students through interactive and multimedia-rich content. This corresponds with the growing body of literature that points out the importance of utilizing digital tools that cater to diverse learning styles and foster active learning environments (Marín-Díaz et al., 2020; Lomos et al., 2023).

The findings of this study highlight important implications for educators and policymakers. Moreover, using such applications can foster students' creativity and critical thinking by offering a more interactive and personalized learning

experience. Policymakers should consider supporting initiatives that facilitate wider access to mobile devices and ensure digital literacy training for students and teachers, which is essential for maximizing the benefits of mobile-based learning. The flexibility and accessibility of Articulate-based learning applications on smartphones make them powerful tools for modern education. As mobile learning continues to grow, educators are encouraged to integrate these tools into their teaching strategies to enhance student engagement and improve learning outcomes (Kim and Park, 2019; Molotsi, 2022).

The flexibility of the developed learning application, particularly its smartphone accessibility, underscores its relevance in modern educational contexts. This mobile learning application, as recognized in current literature, represents a significant advancement in how educational content can be delivered, mobile learning itself is generally said to be a form of learning development that is growing rapidly in the current digital era (Triyono et al., 2022; Metruk, 2022). One concrete manifestation of this is the emergence of various learning applications, which are equipped with learning materials in the form of applications (Gede et al., 2022; Melumad and Pham, 2021). This Articulate-based learning application can also provide opportunities for students to work with their friends to complete assignments and study material together (Heliawati et al., 2022; Sindu et al., 2020). The presence of this media will facilitate students' acquisition of knowledge or comprehension of complex concepts. The forthcoming application will explain in diverse formats, including text, video, and case studies (Daryanes et al., 2023; Abdulah, Mustadi and Fitriani, 2021).

The Future of Mobile App-Based Learning: Implications for Vocational Education

The findings of this study offer several practical implications for educators and policymakers. Firstly, the flexibility and accessibility of Articulate-based learning applications on smartphones underscore their potential as powerful tools for modern education. As mobile learning becomes increasingly significant, educators are encouraged to integrate these innovative tools into their teaching strategies to elevate student engagement and optimize learning outcomes (Schmidthaler et al., 2023).

Similar to several previous studies examining how teachers utilize technology and applications in the learning process, research by Aufa et al. (2021) found that digital learning media in electronic modules could be integrated with a problem-based approach. After going through various stages of testing and implementation, the e-module digital learning media has a lot of positive impacts on improving students' abilities. For instance, the Articulate application has apparently been widely applied at various levels of education. Research by Mawaddah, Tati, and Pagarra (2022) at the basic education level showed that the application of this tool has been reported to gradually improve student learning outcomes. In line with this, research findings by Daryanes et al. (2023) demonstrated that educators in high schools are well-acquainted with the use of Articulate-based applications to support instructional practices. This familiarity can be attributed to the fact that, in addition to enhancing academic performance, digital learning tools have been shown to foster the development of essential 21st-century skills, including critical thinking and creativity. Like research conducted by Istiq'faroh, Suhardi, and Mustadi (2020) that the use of digital learning media in comic format can actually improve students' creative thinking abilities, Yaniawati et al. (2021) in their research also succeeded in proving that students who used mobile learning applications during the learning process were able to think more creatively than students who used printed modules during the learning process. Another research study by Rusnawati, Santyasa, and Tegeh (2021) indicates that using electronic module-based learning media during multiple learning sessions can positively impact students' critical thinking skills. Not only does it affect changes in student competence, digital media for learning also affects changes in teacher abilities, as shown by research conducted by Cocca and Cocca (2024), who conducted a 6-month study on the application of digital media in the format of learning videos for physical education teachers reported findings suggesting that video-based reflection interventions can be a significant component of teacher training programs aimed at enhancing educators' ability to evaluate and respond to various classroom situations. Numerous studies have consistently demonstrated that incorporating digital technology, regardless of its form, can enhance academic performance and foster the development of essential soft skills.

A key factor motivating teachers to integrate technology into learning is the belief that it will positively change students' soft and hard skills (Yılmaz, 2021). In addition, teachers need to pay attention to media and message design. The purpose is to accommodate the material being taught so that attractive learning design using digital learning media can foster students' interest in learning and raise students' self-confidence. The previous point will be related to learning effectiveness, especially when it concerns individual students (De Corte, 2019; Guan, Song and Li, 2018).

While the methodology employed in this study is well-aligned with the research objectives, the findings also highlight the need for further exploration to enhance our understanding of the impact of digital learning media. Future studies could greatly benefit from adopting a mixed-methods approach, combining both quantitative and qualitative data to offer a more nuanced perspective on how Articulate-based learning applications influence student outcomes. Additionally, incorporating a longitudinal study design would allow researchers to examine the long-term effects of these digital tools on a broader range of cognitive and non-cognitive skills, including collaboration, communication, and problem-solving. Although this study primarily focuses on creative thinking skills, expanding the scope of future research to encompass other essential 21st-century skills could provide a more holistic view of the benefits of digital learning media in vocational education. By broadening the investigation, researchers could contribute valuable insights into how these innovative tools can be leveraged to support student development across diverse educational contexts.

In conclusion, this study contributes valuable insights into the role of digital learning media in enhancing creativity among vocational students. However, to further elevate the originality and impact of future research, it is recommended to incorporate

more innovative methodologies and explore new theoretical perspectives. Such approaches will not only strengthen the validity of the findings but also contribute to the ongoing discourse on integrating technology into education.

CONCLUSION

Based on the findings of this study, it can be concluded that the learning application developed by Articulate for graphic design has proven effective in improving students' creative thinking skills. Therefore, this Articulate media is worthy of being positioned as a viable learning media option for learning in the digital era. The positive impact observed in students' creative abilities after using this application underlines its potential as a tool that contributes positively and plays a role in stimulating students' thinking abilities. Furthermore, this study highlights the importance of fostering an environment that supports the integration of Information and Communication Technology (ICT) into teaching and learning practices. Thus, through the results and analysis of this study, it is recommended that teachers adopt Articulate software as a valuable resource for developing interesting and innovative digital learning materials. However, it is important to note that the scope of this study is limited to a specific context, which ultimately affects the generalizability of the results. To address this limitation, future research should consider exploring the effectiveness of the Articulate application at various levels of education and with a larger sample size. This will allow for a broader understanding of the impact of implementing the Articulate application as a learning medium on various aspects, such as engagement, motivation, and academic achievement. In addition, further research could examine the long-term effects of using Articulate and similar digital tools and their potential for integration into various subjects and levels of education. By expanding the scope of research, it is hoped that teachers and education practitioners can gain deeper insights into best practices for implementing ICT-based learning through these tools and maximizing their benefits for student learning outcomes.

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APPENDIX

CREATIVITY SKILLS QUESTIONNAIRE

No.	Statement	Response Options				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Component 1: Fluency						
1.	I can easily come up with many ideas when faced with a problem.					
2.	When asked to create something new, I can generate multiple ideas quickly.					
3.	I find it easy to think of several solutions to a single problem.					
4.	I can think of many different ways to solve a design problem.					
5.	When brainstorming, I often come up with several ideas in a short period.					
Component 2: Flexibility						
6.	I can think of ideas that are different from what most people would think.					
7.	I can generate solutions that are unusual and creative.					
8.	My ideas often stand out because they are unique.					
9.	I often come up with unconventional solutions to problems.					
Component 3: Originality						
10.	I can create new and original ideas when solving a problem.					
11.	My ideas are often fresh and innovative.					
12.	I can find novel ways to approach challenges in creative tasks.					
13.	I can come up with ideas that others have not thought of.					
Component 4: Elaboration						
14.	I can elaborate on ideas and provide detailed explanations.					
15.	I am able to expand and improve upon my initial ideas.					
16.	When working on creative tasks, I focus on refining and developing ideas.					
17.	I pay close attention to details when developing creative concepts.					
Component 5: Evaluation						
18.	I can evaluate my own ideas and decide which one is the best.					
19.	I am able to critically assess my ideas and improve them.					
20.	I can prioritize ideas based on their feasibility and potential impact.					

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