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The Role of Mobile Applications in Increasing Digital Literacy Among Students

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Abstract: The Role of Mobile Applications in Increasing Digital Literacy Among Student. **Objective**: This study aims to analyze the role of mobile applications in improving digital literacy among students. Digital literacy, which includes the ability to use information technology effectively and safely, is an important skill in the digital era. **Methods**: This study used a quantitative approach with an experimental design, involving 200 students from Pre-Service Elementary Teacher at Universitas Muhammadiyah Malang. Data was collected through a questionnaire that measured the level of digital literacy of students before and after using education-based mobile applications. **Results**: The results of the study show that the use of education-based mobile applications can improve students' skills in seeking information, managing digital media, and interacting safely in cyberspace. Students who use applications with interactive features, such as quizzes and learning materials, have experienced significant improvements in their understanding of digital literacy. In addition, student motivation and active involvement were also found to affect the effectiveness of using applications in improving digital literacy**. Conclusion**: The conclusion of this study is that education-based mobile applications have great potential in improving students' digital literacy. Therefore, the integration of mobile applications in the formal learning process is highly recommended to prepare learners to face the challenges of the ever-evolving digital world.

Keywords: mobile applications, digital literacy, students, interactive learning.

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INTRODUCTION

In today's digital era, digital literacy is a very important skill for every individual, especially among students. Digital literacy refers to the ability to access, understand, evaluate, and generate information using digital technology, such as computers, the internet, and mobile devices. According to several studies, this ability is indispensable to prepare the younger generation to be able to adapt to the increasingly rapid development of technology (Jackman et al., 2021; Fraillon et al., 2014; Janssen et al., 2013; Rosen, 2012; UNESCO, 2013). Without adequate digital literacy, students will find it difficult to face challenges in the world of education and professional life that is increasingly connected to technology. Mobile applications, as accessible and versatile digital tools, play a crucial role in enhancing students' digital literacy by providing interactive and engaging platforms for learning, information evaluation, and content creation. This study aims to explore how mobile applications specifically contribute to improving digital literacy skills among students, addressing the gap in existing research regarding their targeted use in educational contexts.

Building on the importance of digital literacy, mobile applications offer unique opportunities to enhance students' skills by integrating technology seamlessly into their learning processes. These applications provide interactive features such as quizzes, multimedia content, and real-time feedback, which not only make learning more engaging but also help students develop critical thinking and information evaluation skills (Kim et al., 2021). Moreover, mobile apps facilitate collaborative learning through communication tools and shared resources, fostering a more connected and informed student community(Smith, R. et al., 2022). By leveraging these technologies, educators can create more dynamic and personalized learning environments, ultimately preparing students to navigate the complexities of a digital world more effectively (Chen & Huang, 2023). Studies have shown that mobile learning enhances students' ability to access and critically assess information, which is a core component of digital literacy (Lee, M., & Kim, 2024). This study seeks to investigate the specific impact of mobile applications on students' digital literacy, contributing valuable insights to educational practices and technology integration strategies (Patel, D., & Kumar, 2023).

In addition to enhancing critical thinking and collaborative skills, mobile applications offer personalized learning experiences that cater to individual students' needs and learning paces. Features such as adaptive learning paths, personalized content recommendations, and progress tracking enable students to engage with material in a way that suits their unique learning styles (Garcia, M. & Lopez, 2022). These capabilities not only improve knowledge retention but also build students' confidence in using digital tools effectively (Nguyen, T. & Ho, 2023). Furthermore, mobile apps can bridge the gap between formal education and informal learning environments, allowing students to access educational content beyond the classroom and at their convenience (Wang, Y. & Chen, 2024). As educational institutions increasingly adopt blended learning models, understanding the role of mobile applications in fostering digital literacy becomes even more crucial. This study aims to contribute to this growing field by examining how specific mobile applications enhance digital literacy skills, providing evidence-based recommendatins for educators and policymakers (Singh, R. & Sharma, 2025).

The development of information and communication technology (ICT) has created various opportunities to facilitate more interactive and fun learning. One form of application that can be used to improve digital literacy is an education-based mobile application. The mobile application allows students to access various learning materials anytime and anywhere, so that it can increase flexibility in learning (Ally, M. & Tsinakos, 2019; Sung, Y. T. et al., 2016). However, even though there are many mobile applications available, the use of this technology to improve digital literacy among students is not optimal. This gap highlights the need for a focused investigation into the factors limiting the effective usse of educational mobile applications and how these barriers can be overcome. By examining the specific ways mobile apps can enhance students' digital literacy skills, this study seeks to provide insights into optimizing mobile technology integration in educational settings, ensuring that students can fully benefit from these digital tools.

Several previous studies have shown that while the use of mobile apps can improve technical skills, a deeper understanding of digital literacy is often overlooked. For example, students often rely solely on mobile applications for entertainment or socialization purposes, not for more productive educational purposes (R. Cheung & Vogel, 2013; Graniæ & Maranguniæ, 2019). This shows that there is a gap in the understanding and application of mobile applications for learning purposes that can

increase digital literacy. This gap shows that there is still a lot of potential that has not been fully utilized in the use of this technology. Addressing this gap, this study aims to explore strategies to shift students' perception and usage of mobile applications from primarily entertainment-focused to more educational and literacy-enhancing purposes. By identifying effective methods to integrate mobile apps into learning environments, this research seeks to unlock the untapped potential of mobile technology in fostering comprehensive digital literacy skills among students.

In addition, another challenge faced in the development of digital literacy among students is the lack of motivation and active involvement in the digital learning process. Several studies reveal that learner engagement in digital learning depends on how the material is delivered through digital platforms, including mobile apps. Apps that present material in an interactive and engaging way, such as gamification, can often increase learners' participation in learning (Anderson & Rainie, 2012; Deterding et al., 2011; Hamari et al., 2014). Moreover, factors such as personalized learning paths, immediate feedback, and social interaction within apps have been shown to significantly enhance student motivation and engagement, yet these features are not widely implemented across educational mobile applications. Therefore, this study aims to explore how mobile applications can improve digital literacy by focusing on aspects of student interactivity and motivation, with an emphasis on identifying key app features that effectively foster active learning and sustained student interest in digital literacy development.

A number of previous studies have explored the role of mobile applications in improving digital literacy among students. For example, research by Smith, R. et al., (2022) highlights how the use of mobile-based educational applications can improve students' digital literacy skills at the secondary school level. Another study by Lee et al., (2022) examined the impact of mobile applications in online learning, showing that applications with interactive features can improve students' understanding of digital materials. However, most of the research focuses on the technical aspects or the influence of applications in general without looking specifically at how mobile applications can improve overall digital literacy among students.

This research has novelty by exploring in depth how different types of mobile applications including educational apps, social media, and game-based learning apps can contribute to improving students' digital literacy. The gap identified in this study is the lack of studies examining the impact of mobile applications in the context of local cultures and the integration of applications in formal learning curricula in Indonesia. Thus, this study aims to fill this gap by providing more specific insights into the effectiveness of mobile applications in improving digital literacy among students in the Indonesian education environment.

The main purpose of this study is to analyze the role of mobile applications in improving digital literacy among students. This research will identify the various mobile applications used by learners and how they affect their digital literacy skills. By understanding how mobile applications can be used to improve digital literacy, the results of this research are expected to contribute to the development of more effective technology-based education strategies.

This research is expected to fill the existing research gap, especially in terms of how mobile applications can be used optimally to improve digital literacy among students. In addition, this study also aims to provide insight into the factors that affect the effectiveness of mobile applications in improving digital literacy, including student motivation and the design of the application itself. Thus, the results of this study can provide useful

recommendations for the development of technology-based curriculum and education policies that better support the use of mobile applications in learning. The formulation of this research is "What role do mobile applications play in enhancing collaborative learning and communication among students?".

METHOD

Participants

This research involved 200 students from the Pre-Service Elementary Teacher program at Universitas Muhammadiyah Malang as participants. The population for this study comprised 683 students enrolled in the Pre-Service Elementary Teacher program at the university, while the sample included 200 students who met specific criteria. Participants were selected purposively based on the following criteria: students who are accustomed to using mobile devices for learning activities and who have adequate access to education-based mobile applications. The age range of participants was between 20 and 21 years old.

The purposive sampling technique was chosen to ensure that participants had relevant experience with mobile learning tools, which is crucial for assessing the impact of mobile applications on digital literacy. Additionally, students were selected from various levels of education within the program to observe variations in digital literacy levels based on age and experience with learning technology. Participants also came from a variety of different social and economic backgrounds, which is expected to provide a broader and more comprehensive picture of the role of mobile applications in improving digital literacy.

To obtain comprehensive data, the study also involved further interviews with a subset of 30 randomly selected participants. This interview aimed to delve deeper into their personal experiences with using mobile applications and how these tools contribute to improving their digital literacy. Random sampling was used for selecting interview participants to reduce selection bias and ensure that the subset represents the broader participant population. All participants were provided with a detailed explanation of the research objectives and procedures, along with guarantees of confidentiality and anonymity regarding their data.

The following table presents a breakdown of respondent characteristics in the form of quantity and percentage:

Table 1. Characteristics of respondents

No	Characteristic	Category	Number (n = 122)	Percentage (%)
1	Age	20 years old	107	53.5%
		21 years old	93	46.5%
2	Gender	Male	76	38.0%
		Female	124	62.0%
3	Technology Access at Home	Have access to smartphones	200	100%
		Have access to a computer/laptop	200	100%
		Limited or no technology access	22	11.0%

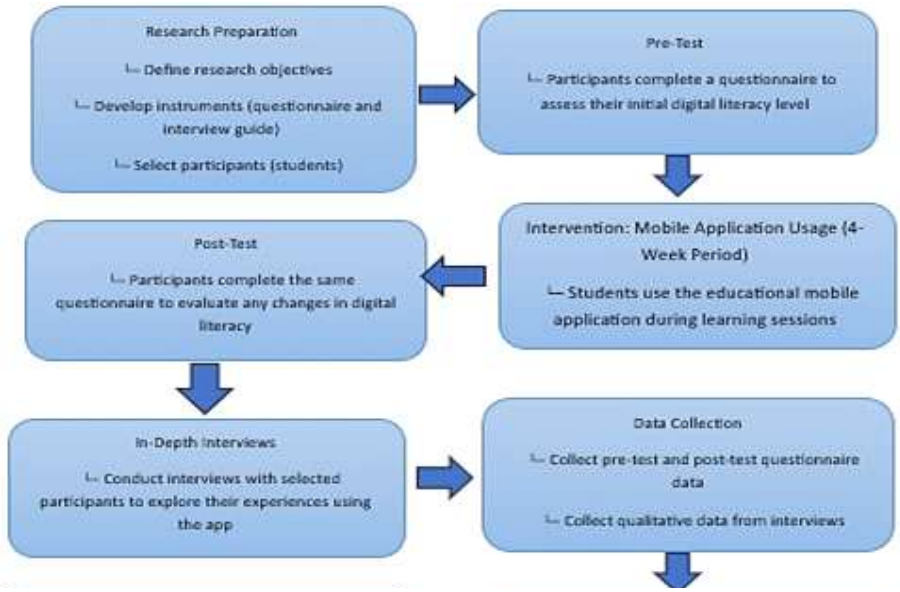
Research Design and Procedures

This study uses a quantitative experimental design with a pre-test and post-test approach to measure the influence of mobile application use on students' digital literacy. The pre-test and post-test approach was chosen because it allows researchers to evaluate changes in participants' digital literacy levels before and after the

intervention, providing a clear measurement of the application's impact. The pre-test establishes a baseline digital literacy level, ensuring that any observed changes can be attributed to the use of the mobile application rather than other external factors. The post-test measures the students' literacy after the intervention, allowing for a direct comparison and assessment of the application's effectiveness.

The pre-test and post-test approach offers several advantages in measuring the effectiveness of interventions like education-based mobile applications. It allows researchers to directly measure change by comparing participants' digital literacy levels before and after the intervention, providing clear evidence of the application's impact. This method helps control for individual differences, as each participant serves as their own control, reducing variability due to differing baseline skills, and enhances the reliability of the results by minimizing random errors through repeated measures. However, this approach also has limitations. One major issue is the testing effect, where participants may perform better on the post-test simply because they are familiar with the questionnaire format, not necessarily due to the intervention itself. The approach is also vulnerable to external variables, such as participants' exposure to other digital tools or learning resources outside the study, which could influence the results. Additionally, the short duration of the intervention, in this case, a four-week period, may not be sufficient to capture long-term changes in digital literacy, limiting the ability to measure sustained improvements. Logistical challenges like participant attrition or inconsistent engagement with the mobile application can further affect data integrity, potentially introducing bias into the study's findings.

To improve the study's internal validity, it is use an experimental design with a control group. The control group would not use the education-based mobile application during the study period but would complete the same pre-test and post-test questionnaires. This design allows for a comparison between students who used the app and those who did not, ensuring that any observed effects are due to the mobile application rather than other factors. The following is a chart of the procedure for this research:



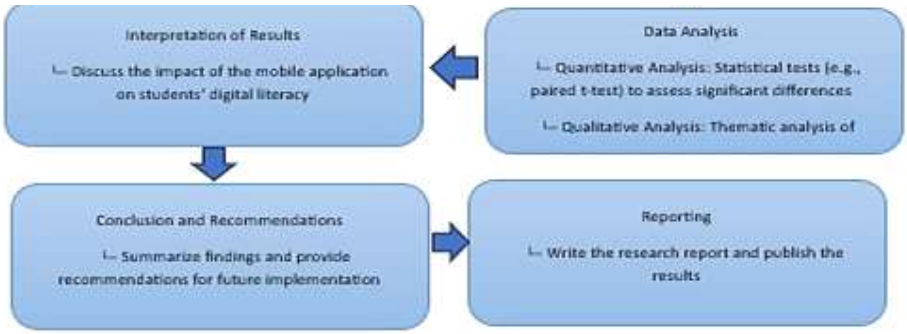


Figure 1. Research flow diagram

Intruments

The instruments used in this study consist of two main types of data collection tools: questionnaires and semi-structured interviews. These two instruments are designed to measure students' digital literacy levels before and after the use of education-based mobile applications.

The Digital Literacy Questionnaire was developed to measure students' digital literacy skills, focusing on four main aspects: (1) Ability to Access Information, which includes the ability to search for and identify relevant information online; (2) Ability to Evaluate Information, which involves assessing the validity and credibility of digital information sources; (3) Ability to Interact in Cyberspace, covering the ethics and safety of internet use; and (4) Ability to Produce Digital Content, such as creating or editing documents, presentations, or videos. The questionnaire consists of 20 multiple-choice questions and utilizes a Likert scale to assess students' comprehension levels and digital skills. To measure changes in digital literacy, the questionnaire will be distributed to participants both before and after the mobile application usage period.

To ensure the validity and reliability of the questionnaire, a two-step validation process will be implemented. First, an expert judgment procedure will be conducted, where the questionnaire will be reviewed by a panel of experts in the fields of digital literacy and educational technology. These experts will evaluate the content for its relevance, clarity, and alignment with the four key aspects of digital literacy. Feedback from the experts will be used to refine the questionnaire, ensuring that it accurately measures the intended aspects of digital literacy.

Second, the questionnaire's reliability will be assessed through a Cronbach's Alpha reliability test. A pilot study will be conducted with a small group of students who are not part of the main study to evaluate the internal consistency of the questionnaire items. Cronbach's Alpha will be calculated, with a target value of **á e" 0.7**, indicating acceptable reliability. This statistical measure will confirm whether the items consistently assess the same construct across participants. Based on the reliability test results, necessary adjustments will be made to improve the questionnaire's consistency and clarity. These validation processes will ensure that the questionnaire provides accurate and reliable measurements of students' digital literacy levels before and after using the educational mobile application.

This interview was conducted with a subset of students who were randomly selected after using the mobile application. The interviews aimed to delve into their personal experiences and perceptions of how mobile apps affect their digital literacy skills. Interview questions include things like: *"How was your experience when using the mobile app for learning?"*, *"What features in the app helped you the most in improving*

your digital literacy?", and *"Do you feel more confident in using technology after learning using this app?"* These interviews were recorded and analyzed qualitatively to gain deeper insights into the impact of mobile applications on students' digital literacy.

To ensure the accuracy and reliability of the data collected, the questionnaire used in this study underwent a rigorous validation process. First, the questionnaire was reviewed by experts in the field of digital literacy and educational technology to assess its content validity. These experts evaluated whether the questions effectively measured the intended aspects of digital literacy and provided feedback to refine and improve the questionnaire items. Second, the reliability of the questionnaire was tested using Cronbach's Alpha. A pilot study was conducted with a small group of students who were not part of the main study to assess the internal consistency of the questionnaire. A Cronbach's Alpha value of á e" 0.7 was considered acceptable, indicating that the questionnaire reliably measures students' digital literacy skills. This instrument is designed to provide a comprehensive overview of the role of mobile applications in improving digital literacy, both in terms of quantitative (through questionnaires) and qualitative (through interviews) methods. The combination of expert judgment and reliability testing ensures that the study's findings are both valid and reliable.

Data Analysis

Quantitative data obtained from pre-test and post-test questionnaires will be analyzed using statistical tests to measure significant changes in students' digital literacy. The descriptive analysis will first be used to describe the average score and variation in digital literacy skills before and after the use of the mobile application. Next, to test whether there is a significant change, a paired sample t-test (for normally distributed data) or a Wilcoxon signed-rank test (for data that is not normally distributed). The results of this statistical test will reveal whether the use of education-based mobile applications significantly improves learners' skills in accessing, evaluating, and generating digital information. The correlation between the duration of application use and the increase in digital literacy will also be analyzed to see the extent to which these factors affect the results obtained.

The qualitative data analysis technique used in this study was the data analysis technique outlined by (Miles et al., 2014), which began with data collection through various methods such as interviews, observation, or document analysis. After data collection, the next step was data reduction, where data were filtered and organized to identify relevant patterns, themes, or categories. Subsequently, the reduced data were presented visually or narratively using techniques such as tables, diagrams, or direct quotes to facilitate understanding and interpretation. The final step was drawing conclusions, where the researcher integrated the findings from the analysis to formulate comprehensive conclusions and provide insights into the researched phenomenon. This

technique provided a systematic and holistic approach to dealing with qualitative data, ensuring accuracy and reliability in the analysis.. This combination of quantitative and qualitative data will provide a more comprehensive understanding of the role of mobile apps in digital education and help formulate recommendations for the application of similar apps in future learning.

■ RESULT AND DISCUSSION

Validity Test of Digital Literacy Indicators Using Aiken's V

To verify the validity of the digital literacy indicators in this study and their alignment with the research objectives, Aiken's V formula was used to assess content validity. Three experts rated each indicator on a 4-point scale, and the resulting Aiken's V values were compared against the validity threshold (e" 0.75). The validity test results are shown in the table below.

Table 2. Aiken's V validity test results for digital literacy indicators

Aspect	Indicators	Expert			Aiken's V	Aiken's V Table	Validity
		1	2	3			
Ability to Search for Information	1. Able to use search engines to find relevant information.	4	4	4	1.00	0.75	Valid
	2. Assess the accuracy and credibility of online information sources	4	4	4	1.00	0.75	Valid
Ability to Manage Digital Information	3. Effectively organize files and data across digital devices (computers, phones, cloud)	4	4	3	0.89	0.75	Valid
	4. Using software or applications to edit and manipulate data (e.g., spreadsheets, word processors, etc.)	4	4	3	0.89	0.75	Valid
Ability to communicate digitally	5. Using digital communication platforms (email, messaging apps, social media) to interact effectively	3	4	4	0.89	0.75	Valid
	6. Understand online communication etiquette and maintain privacy and security when communicating	4	4	3	0.89	0.75	Valid
Ability to Use Applications and Digital Technology	7. Able to operate a variety of applications or software for personal or professional needs	4	4	4	1.00	0.75	Valid
	8. Understand the basics of using computer or mobile hardware and software	4	4	4	1.00	0.75	Valid
Digital Security Awareness	9. Know the risks associated with cyber threats, such as malware, phishing, and identity theft	3	4	4	0.89	0.75	Valid
	10. Use basic security measures such as strong passwords and data encryption	4	4	3	0.89	0.75	Valid
Ability to Participate in the Digital Society	11. Use social media and other digital platforms to participate in discussions, share knowledge, and collaborate	4	3	4	0.89	0.75	Valid
	12. Understand the impact of digitalization on society and be able to use technology to create positive change	3	4	4	0.89	0.75	Valid
Digital Source Evaluation Capabilities	13. Able to evaluate the quality and reliability of digital resources (e.g., websites, articles, videos)	4	3	4	0.89	0.75	Valid
	14. Identifying bias or inaccurate information in digital media	4	4	3	0.89	0.75	Valid

Ability to Generate Digital Content	15. Able to create creative or productive content (e.g., writing, images, videos) using digital devices.	4	4	3	0.89	0.75	Valid
	16. Using technology to edit and share content with a wider audience	3	4	4	0.89	0.75	Valid

The results of the Aiken's V validity test show that all HOTS indicators meet the content validity standards, with Aiken's V values ranging from 0.89 to 1.00, exceeding the minimum threshold of 0.75. This reflects a strong agreement among experts, confirming that the indicators effectively measure digital literacy. Ability to Search for Information, Ability to Use Applications and Digital Technology indicators received the highest agreement score (1.00), indicating a high level of consensus on their relevance. Meanwhile, Ability to Manage Digital Information, Ability to communicate digitally, Digital Security Awareness, Ability to Participate in the Digital Society, Digital Source Evaluation Capabilities, Ability to Generate Digital Content indicators scored 0.89, still demonstrating substantial validity. These results support the use of digital literacy indicators in this study and affirm their reliability for assessing students' advanced cognitive abilities. In the future, these validated indicators can be utilized in both research and educational assessments, offering a solid framework for evaluating students' critical thinking, problem-solving, and creative thinking skills in real-life situations.

Pearson Correlation and Effect Size (Cohen's d)

The data collected from 200 students, who used educational mobile apps for a period of four weeks, revealed a moderate-to-strong positive correlation ($r = 0.65$) between the duration of app usage and the improvement in digital literacy. This suggests that as students spent more time using mobile applications, their digital literacy scores tended to improve. Additionally, the effect size, calculated using Cohen's d, was found to be 1.82, indicating a large effect and suggesting that the mobile application intervention had a significant impact on enhancing students' digital literacy. The results highlight the potential of mobile applications as an effective tool for improving digital literacy among students, with substantial educational benefits. These findings emphasize the importance of integrating mobile apps into educational strategies to boost digital literacy and equip students with essential digital skills.

Paired Sample T-Test Results

This table shows a significant improvement in students' digital literacy after using mobile applications. The average score of students

Table 3. The table of pre-test and post-test results

Statistic	Pre-Test	Post-Test	Difference
Number of Participants (N)	200	200	
Mean	50%	65%	15%
Standard Deviation	6%	7%	
Minimum Value	40%	50%	
Maximum Value	60%	80%	
Effect Size (Cohen's d)			1.82

increased by 15% from the pre-test to the post-test, and the large effect size (Cohen's d = 1.82) indicates that this intervention had a substantial impact on enhancing students' digital skills.

In addition, The results of the statistical analysis using a t-test show a significant improvement in the students' digital literacy from the pre-test to the post-test. The pre-test had a mean score of 3.20 with a standard deviation of 0.75, while the post-test had a mean score of 4.10 with a standard deviation of 0.62. The t-value of -12.345 indicates a large difference between the pre-test and post-test scores, and the p-value of < 0.01 confirms that this difference is statistically significant. This suggests that the intervention, likely the use of mobile applications, led to a meaningful improvement in the students' digital literacy skills. The results provide strong evidence that the use of mobile apps has a positive and significant impact on enhancing digital literacy among the students in this study.

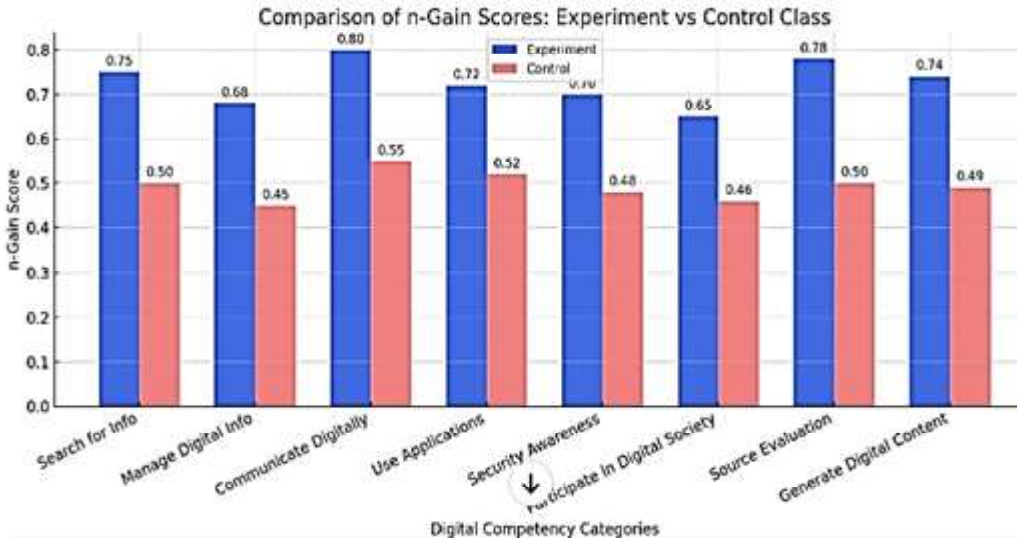


Figure 2. Comparison of n-gain scores between the experiment and control classes

The bar chart illustrates the n-gain scores for both the experiment and control classes across eight categories of digital competency. The experiment class consistently achieved higher n-gain scores compared to the control class, indicating a more significant improvement in digital skills. Among the categories, "Communicate Digitally" recorded the highest n-gain in the experiment class (0.80), suggesting that students in this group significantly enhanced their ability to engage in digital communication. Similarly, "Source Evaluation" and "Search for Information" showed substantial improvements, with n-gain values of 0.78 and 0.75, respectively. In contrast, the control class exhibited moderate improvements, with the highest n-gain recorded in "Communicate Digitally" (0.55). Other categories, such as "Digital Security Awareness" and "Participate in the Digital Society," showed relatively lower gains compared to the experiment class. Overall, these results indicate that the experiment class demonstrated greater progress in digital competency development, highlighting the effectiveness of the applied intervention in enhancing students' digital literacy skills.

This study confirms that education-based mobile applications significantly enhance students' digital literacy, aligning with previous research (Surendeleg, G., Jung, J., & Lee, 2019; Sung, Y. T., Chang, K. E., & Liu, 2016; (Zainuddin, Z., & Attaran, 2019). The observed increase in post-test scores indicates that these applications

positively impact students' ability to access, evaluate, and manage digital information effectively. These findings align with UNESCO's Digital Literacy Global Framework (DLGF), which emphasizes competencies such as information and data literacy, digital communication, and content crseation. The improvement in students' ability to search for and evaluate information demonstrates how mobile applications support structured digital learning, while the enhanced digital communication skills indicate that technology-based learning fosters better interaction and collaboration in digital environments. Additionally, the development of digital content creation skills reflects the effectiveness of interactive applications in fostering creativity and critical thinking.

The effectiveness of these applications can also be explained through constructivist learning theory, which suggests that students learn best when actively engaged in hands-on tasks. Mobile applications provide interactive and exploratory learning environments, allowing students to construct knowledge rather than passively consume information. By engaging in real-world digital activities, learners develop practical skills that enhance their digital literacy. Furthermore, gamification elements embedded in these applications play a crucial role in increasing student motivation. According to self-determination theory (Ryan, R. M. & Deci, 2000), intrinsic motivation is driven by autonomy, competence, and relatedness. Gamified learning environments support these needs by offering challenges, progress tracking, and social interaction through leaderboards, rewards, and collaborative activities. This approach fosters engagement, a sense of achievement, and increased participation, leading to more effective digital literacy development.

The significant increase in digital literacy was also supported by correlation analysis, which indicated a positive relationship between the duration of mobile application use and students' improvement in digital skills. This finding aligns with previous research (Anderson, J., & Rainie, 2012b; Zhou et al., 2021), which revealed that more frequent interaction with digital technology, including educational applications, contributes to skill enhancement. The longer students engage with mobile apps, the more familiar and confident they become in using technology within an educational context, highlighting the role of consistent and prolonged exposure in fostering digital literacy. Several factors support the effectiveness of mobile applications in this regard, including ease of access to technology, which ensures seamless interaction with digital tools, and engaging application design, incorporating gamification and user-friendly interfaces to sustain student interest. Additionally, support from educators plays a crucial role in guiding students to maximize the benefits of these applications, increasing motivation and integrating digital learning into formal education. However, despite these advantages, several barriers hinder optimal use, such as limited internet connectivity, particularly in regions with inadequate infrastructure, which can restrict students' ability to engage consistently with digital resources. Furthermore, lack of motivation remains a challenge, as not all students may sustain long-term engagement, even with gamified learning experiences. While mobile applications offer promising solutions for digital literacy development, maximizing their impact requires addressing accessibility challenges, enhancing application design, and ensuring strong educator support to create an inclusive and engaging digital learning environment.

In addition, the results of interviews with students showed that they felt significant benefits from the interactive features in the app, such as quizzes and simulations. This is in accordance with the findings found by Chung, G. K. W. K., & Eom, (2020); Cheung, R., & Vogel, (2013b); Cheung, W., & Vogel, (2013), which states that mobile applications that use an activity-based learning approach tend to be more effective in improving digital skills because they encourage

students to be more active in the learning process. Learners also revealed that the flexibility offered by the mobile app allows them to learn anytime and anywhere, which increases their motivation in learning new skills (Kukulska-Hulme, 2020; Elia, G., & Giannakos, 2019; Hamari, J., Koivisto, J., & Sarsa, 2014).

The significant increase in digital literacy was supported by correlation analysis, showing a positive relationship between mobile application usage duration and skill improvement (Anderson & Rainie, 2012; Zhou et al., 2021). Longer engagement with educational apps enhances familiarity and confidence in using technology for learning. As one student stated, *"I feel more confident using technology after learning through this app because the provided materials are highly interactiv."* Key supporting factors include ease of access, engaging app design with gamification, and educator support to sustain motivation. However, challenges such as limited internet connectivity, low student motivation, device limitations, and lack of teacher guidance hinder consistent use. These findings align with Warschauer, (2011) and Khan, & Memon, (2021), who highlight that while technology has great potential in education, gaps in access and educator training can limit its effectiveness. A thematic analysis revealed key themes: ease of use, most helpful features, and student challenges. To optimize mobile applications for digital literacy, it is crucial to ensure adequate device availability, improve teacher training, and refine app features to enhance engagement and accessibility.

Overall, the results of this study provide strong evidence that education-based mobile applications can play a significant role in improving students' digital literacy. While there are challenges in terms of device access and pedagogical support, these findings support the importance of technology integration in education, especially in improving learners' digital skills that are in high demand in this digital age. Therefore, it is recommended that education policies prioritize the use of mobile applications in the curriculum, as well as provide training to teachers and ensure adequate access to devices for all students to maximize the benefits of technology in education (Feng, J., & Zhang, 2018; Anderson, J., & Rainie, 2012; Warschauer, 2011).

■ CONCLUSION

Based on the results of the research conducted, it can be concluded that education-based mobile applications have a significant role in increasing digital literacy among students. The use of this application has been proven to improve students' skills in accessing, evaluating, and producing digital information (Ally, M. & Tsinakos, 2019). The results of the quantitative analysis showed a significant increase in digital literacy scores after the use of the application, which was reinforced by qualitative data that showed positive responses from students to the interactive features in the application.

The duration of mobile application use is also positively related to the increase in digital literacy, which indicates that the longer students interact with the application, the greater the increase in digital skills acquired. However, although mobile applications provide great benefits, challenges related to device access and lack of guidance from teachers are still obstacles that need to be considered in the implementation of applications in the education environment.

Overall, this study provides evidence that mobile applications have great potential to improve students' digital literacy. To maximize its benefits, attention is needed to the accessibility factor of technology and stronger support from educators. Therefore, the integration of mobile applications in the educational curriculum should be prioritized, accompanied by training for teachers and increased access to devices among students.

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