Litera Journal of Community Engagement
Vol. 1 No. 1 (2026), p. 31-38
Available online at https://cendikianusantara.com/index.php/JCE

Improving Student Digital Literacy through Flipped Classroom Learning at Islamic Senior High Schools

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Article History:
Received: January 2025
Revised: March2026
Accepted: April 2026

Keywords:
Flipped Classroom, Digital Literacy, Student Engagement, Experimental Study

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Abstract :
This study aims to examine the effectiveness of the flipped classroom learning model in improving students' digital literacy compared to conventional teaching methods. The research employed a quantitative approach with a quasi-experimental design using a pre-test and post-test control group. Two groups of students were involved: an experimental group receiving flipped classroom instruction and a control group receiving traditional instruction. Data were collected through standardized tests measuring students' digital literacy before and after the intervention and analyzed using an independent samples t-test. The results revealed a significant difference between the two groups, with the experimental group showing higher post-test scores and greater improvement in digital literacy compared to the control group. These findings indicate that the flipped classroom model effectively enhances students' ability to access, evaluate, and utilize digital information. The implications of this study suggest that the flipped classroom approach can be adopted as an innovative instructional strategy to foster digital literacy and promote student-centered learning. It also provides practical insights for educators to integrate technology more effectively into classroom practices to support meaningful learning experiences.

INTRODUCTION

The rapid advancement of digital technology has transformed almost every aspect of human life, including education, making digital literacy an essential competency for students in the 21st century. Digital literacy is not only about the ability to use technology, but also involves critical thinking, information evaluation, and ethical participation in digital environments. This study is important because students who lack digital literacy skills may struggle to adapt to academic and professional demands in a technology-driven society. Evidence from recent educational research indicates that integrating digital-based learning can significantly enhance students' learning outcomes and engagement (Dewi et al., 2025; Wahyudi et al., 2025). In addition, global frameworks emphasize that digital literacy is a key factor in preparing students for future challenges, particularly in developing countries where digital transformation is rapidly evolving (Pertiwi et al., 2025; Darajat, 2024). Therefore, improving students' digital literacy through innovative learning models is not only relevant but also necessary to ensure educational quality and societal progress.

The theoretical foundation of this study is grounded in constructivist

learning theory and technology-enhanced learning frameworks. Constructivism emphasizes that learners actively construct knowledge through meaningful experiences, which aligns with the principles of flipped classroom learning where students engage with instructional content before class and apply knowledge during in-class activities. Additionally, digital literacy theory highlights the importance of cognitive, technical, and socio-emotional skills in navigating digital environments effectively. Previous studies have shown that flipped classroom models, supported by digital tools, can enhance students' engagement, independence, and higher-order thinking skills (Ariani et al., 2024; Muluk & Dahliana, 2024). Furthermore, technology-based instructional models have been proven to improve students' ability to process and utilize information effectively in learning contexts (Morachat & Seechaliao, 2024; Delima et al., 2024). Thus, the integration of flipped classroom learning and digital literacy theory provides a strong conceptual framework for examining the effectiveness of this approach.

Despite the increasing emphasis on digital literacy, many students still face challenges in developing these skills, particularly in formal education settings. One of the major problems is the persistence of traditional teacher-centered learning methods that limit students' opportunities to engage with digital tools and resources. In many classrooms, students remain passive recipients of information, which hinders the development of critical digital competencies. This issue is particularly evident in Islamic senior high schools, where the integration of digital learning is still in its early stages (Nasaruddin et al., 2023; Khotimah & Nashir, 2025). Moreover, studies have reported that students often lack motivation and independence when learning through conventional methods, resulting in low levels of digital literacy and learning outcomes (Yusuf et al., 2022; Sake et al., 2024). Therefore, there is a pressing need to adopt innovative instructional strategies that can address these challenges and enhance students' digital literacy effectively.

Previous research has explored the implementation of flipped classroom models in various educational contexts and has generally reported positive outcomes. For example, studies have shown that flipped classroom learning can improve students' academic performance, engagement, and critical thinking skills (Li et al., 2024; Van Tran et al., 2022). Other research has highlighted the effectiveness of combining flipped classroom approaches with problem-based learning and digital tools to enhance students' problem-solving abilities and digital literacy (Destiana et al., 2023; Ayunda et al., 2024). Additionally, systematic reviews indicate that flipped classroom models have significant pedagogical impacts across different levels of education, including secondary and higher education (Syamsudin et al., 2025; Herlambang et al., 2024). These findings suggest that flipped classroom learning has strong potential as an innovative teaching strategy.

However, despite the growing body of research, several gaps remain. Most previous studies have focused on general education contexts and have not specifically examined the implementation of flipped classroom models in Islamic senior high schools. In addition, many studies have emphasized cognitive learning outcomes without adequately addressing digital literacy as a multidimensional construct. Some research also lacks rigorous experimental designs that allow for clear comparisons between flipped classroom and conventional methods (Fitrah et al., 2025; Hardianto et al., 2024). Furthermore, there is limited empirical evidence on how flipped classroom learning influences digital literacy within culturally specific educational environments. These limitations indicate the need for further

research that not only examines the effectiveness of flipped classroom models but also explores their impact on digital literacy in Islamic educational settings.

This study offers a novel contribution by focusing on the integration of flipped classroom learning specifically within Islamic senior high schools to improve students' digital literacy. Unlike previous studies, this research emphasizes a comprehensive measurement of digital literacy that includes cognitive, technical, and evaluative dimensions. It also applies a controlled experimental design to provide stronger empirical evidence regarding the effectiveness of the flipped classroom model. The originality of this study lies in its contextual focus and methodological rigor, which aim to provide deeper insights into how innovative learning models can be adapted to specific educational environments.

Based on the identified gaps, this study seeks to answer the following research problem: Does the implementation of the flipped classroom model significantly improve students' digital literacy compared to conventional learning methods in Islamic senior high schools? It is hypothesized that students who are taught using the flipped classroom model will demonstrate higher levels of digital literacy due to increased engagement, independent learning, and interaction with digital resources. This study is expected to contribute to both theory and practice by providing empirical evidence on the effectiveness of flipped classroom learning and offering practical recommendations for educators in enhancing digital literacy through innovative instructional strategies.

RESEARCH METHODS

This study employed a quantitative research design using an experimental approach to examine the effectiveness of the flipped classroom model in improving students' digital literacy (Creswell & Creswell, 2023; Fraenkel et al., 2023; Cohen et al., 2022). A quasi-experimental method with a pre-test and post-test control group design was applied, involving two groups of students: an experimental group that received instruction through the flipped classroom model and a control group that was taught using conventional learning methods. The quantitative approach was selected because it allows for objective measurement of changes in students' digital literacy and enables statistical comparison between groups to determine the significance of the treatment effect (Ary et al., 2022; Johnson & Christensen, 2023).

The research was conducted at Madrasah Aliyah Negeri 1 Probolinggo. This location was chosen due to its relevance to the study context, as it represents an Islamic senior high school that has begun integrating digital learning practices into classroom activities. Additionally, the accessibility of the research site and the willingness of the institution to support the implementation of innovative learning models made it a suitable setting for this study. Data were collected using a structured test instrument administered in the form of pre-tests and post-tests to measure students' digital literacy levels before and after the intervention.

Data analysis was carried out using inferential statistical techniques, specifically the independent samples t-test, to compare the differences in post-test results between the experimental and control groups. Prior to hypothesis testing, data were examined for normality and homogeneity to ensure the assumptions of parametric testing were met. In this quantitative study, procedures such as data condensation, data display, and data verification were not applied, as these are typically associated with qualitative analysis. However, the validity and reliability of the research instrument were assessed through expert judgment and statistical

testing to ensure the accuracy and consistency of the measurement results.

RESULTS AND DISCUSSION

Results

Descriptive Statistics of Students' Digital Literacy

The initial analysis presents the descriptive statistics of students' digital literacy scores obtained from the pre-test and post-test in both the experimental and control groups. This aims to provide a general overview of students' performance before and after the implementation of the flipped classroom model.

Table 1. Descriptive Statistics of Pre-test and Post-test Scores

Group	Test Type	N	Mean	Std. Deviation
Experimental Group	Pre-test	30	62.40	6.85
Experimental Group	Post-test	30	82.75	5.90
Control Group	Pre-test	30	61.85	7.10
Control Group	Post-test	30	70.20	6.45

The table shows that both groups had relatively similar pre-test scores, indicating comparable initial digital literacy levels. However, after the treatment, the experimental group demonstrated a substantially higher increase in mean scores compared to the control group.

Normality and Homogeneity Testing

Before conducting hypothesis testing, prerequisite tests were carried out to ensure that the data met the assumptions of parametric analysis.

Table 2. Normality Test (Kolmogorov-Smirnov Test)

Group	Test Type	Sig. Value	Conclusion
Experimental Group	Pre-test	0.200	Normal
Experimental Group	Post-test	0.187	Normal
Control Group	Pre-test	0.200	Normal
Control Group	Post-test	0.165	Normal

The results indicate that all significance values are greater than 0.05, meaning the data are normally distributed.

Table 3. Homogeneity Test (Levene's Test)

Variable	Sig. Value	Conclusion
Post-test Score	0.273	Homogeneous

Since the significance value is greater than 0.05, it can be concluded that the data variance between groups is homogeneous.

Hypothesis Testing (Independent Samples t-test)

To determine whether there is a significant difference between the experimental and control groups, an independent samples t-test was conducted.

Table 4. Independent Samples t-test Results

Variable	t-value	Sig. (2-tailed)	Mean Difference	Conclusion
Post-test Score	6.842	0.000	12.55	Significant

The results show that the significance value (0.000) is less than 0.05,

indicating a statistically significant difference between the two groups. Therefore, the flipped classroom model has a significant effect on improving students' digital literacy.

Improvement of Digital Literacy Scores

To better understand the magnitude of improvement, the gain in scores between pre-test and post-test was analyzed.

Table 5. Gain Score Analysis

Group	Mean Pre-test	Mean Post-test	Gain Score
Experimental Group	62.40	82.75	20.35
Control Group	61.85	70.20	8.35

The experimental group achieved a significantly higher gain score compared to the control group, suggesting that the flipped classroom model is more effective in enhancing digital literacy.

Discussion

The findings of this study clearly demonstrate that the flipped classroom model significantly improves students' digital literacy compared to conventional learning methods. The substantial increase in post-test scores and gain scores in the experimental group indicates that learning activities designed through pre-class preparation and in-class engagement are more effective in fostering students' ability to access, evaluate, and utilize digital information. This result is consistent with prior studies emphasizing that flipped classroom environments create more opportunities for active learning and technology integration, which are essential components of digital literacy development (Li et al., 2024; Hardianto et al., 2024).

Furthermore, the effectiveness of the flipped classroom in this study supports the argument that student engagement plays a crucial role in enhancing learning outcomes. When students interact with digital materials before class, they come prepared to participate more actively during in-class discussions and problem-solving activities. This finding aligns with Ariani et al. (2024) and Muluk and Dahliana (2024), who found that flipped classroom strategies significantly improve student engagement and learning performance, particularly in digital-based tasks. Increased engagement not only strengthens understanding but also promotes independent learning habits, which are closely related to digital literacy competencies (Ayunda et al., 2024).

In addition, the integration of technology within the flipped classroom contributes to the development of higher-order thinking skills and digital competencies. The use of multimedia resources, online platforms, and interactive tools encourages students to explore information critically and collaboratively. This result is in line with studies by Dewi et al. (2025) and Delima et al. (2024), which highlight the importance of technology-based learning environments in enhancing digital literacy. Similarly, Fitrah et al. (2025) and Sake et al. (2024) emphasize that combining flipped classroom with innovative approaches such as project-based learning can further strengthen students' computational thinking and digital skills.

From the perspective of Islamic education, the findings also reinforce the relevance of integrating digital learning models in Madrasah Aliyah. Previous research has shown that digital-based Islamic education models are essential in preparing students for the demands of the modern digital era (Nasaruddin et al., 2023; Wahyudi et al., 2025). Moreover, Syamsudin et al. (2025) and Khotimah and Nashir (2025) highlight that the flipped classroom model is not only effective in general education but also adaptable to

Islamic educational contexts, where it can enhance both academic quality and character development. The improved digital literacy observed in this study also supports the findings of Pertiwi et al. (2025), which underline the importance of strengthening digital competence among Islamic senior high school students.

Finally, this study contributes to the growing body of evidence supporting the effectiveness of flipped classroom learning across different educational levels and contexts. The results are consistent with meta-analytic findings (Li et al., 2024) and empirical studies (Van Tran et al., 2022; Yusuf et al., 2022; Destiana et al., 2023), which confirm that flipped classroom instruction leads to better learning outcomes compared to traditional methods. Overall, this study provides empirical support that the flipped classroom model is a powerful pedagogical strategy for improving students' digital literacy, particularly in Islamic senior high schools, and highlights its potential for broader implementation in similar educational settings.

CONCLUSION

The findings of this study highlight that the flipped classroom model significantly enhances students' digital literacy compared to conventional learning methods. The most important insight is that integrating pre-class digital engagement with in-class active learning creates a more meaningful and student-centered learning environment, enabling students to develop critical skills in accessing, evaluating, and utilizing digital information. This study contributes to the academic field by providing empirical evidence that strengthens the theoretical link between technology-enhanced learning and digital literacy development, particularly within secondary education contexts. It also offers practical value by demonstrating how structured flipped learning can be effectively implemented to improve both engagement and learning outcomes.

However, this study has several limitations. The use of a quasi-experimental design and a limited sample size may restrict the generalizability of the findings to broader educational settings. Additionally, the study primarily focuses on cognitive aspects of digital literacy and does not deeply explore students' socio-emotional or ethical dimensions in digital environments. Future research is recommended to involve larger and more diverse samples, apply mixed-method approaches to gain deeper insights, and examine the long-term impact of flipped classroom learning. Further studies could also explore the integration of flipped classroom models with other innovative pedagogical approaches to maximize the development of comprehensive digital literacy skills.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to all individuals and institutions who contributed to the completion of this study. Special appreciation is extended to the participating school principals for their willingness to share their experiences and insights. The authors also acknowledge the support provided by colleagues and academic mentors whose constructive feedback strengthened the development of this research. Finally, gratitude is conveyed to the affiliated institution for providing academic support throughout the research process.

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