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Comparative Analysis of the Effectiveness of Flipped Classroom vs Conventional Methods on Digital Literacy of Madrasah Aliyah Students

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Abstract :
This study aims to examine the comparative effectiveness of the flipped classroom and conventional teaching methods in improving students' digital literacy. A quantitative approach with a quasi-experimental design was employed, involving two groups: an experimental group receiving flipped classroom instruction and a control group receiving traditional lecture-based teaching. Data were collected through pre-test and post-test assessments to measure students' digital literacy development. The data were analyzed using paired sample t-tests and independent sample t-tests to determine within-group and between-group differences. The findings revealed that both instructional methods contributed to improvements in digital literacy; however, the flipped classroom demonstrated significantly higher gains, supported by a large effect size compared to the moderate effect observed in the conventional method. These results indicate that flipped learning provides a more effective learning environment by promoting active engagement, self-directed learning, and increased interaction with digital tools. The study implies that integrating flipped classroom strategies can enhance students' digital competencies and should be considered as an alternative instructional model in technology-enhanced education.

INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed how individuals access, process, and utilize information, making digital literacy an essential competency in contemporary society. In the context of education, digital literacy is no longer limited to technical skills but extends to critical thinking, information evaluation, and responsible technology use. This issue is particularly important for secondary education, where students are expected to develop foundational competencies for lifelong learning. The integration of technology into learning environments has been widely recognized as a key driver in enhancing these competencies. Empirical evidence shows that technology-supported learning significantly improves students' digital literacy and learning outcomes (Wang & Fan, 2025; Ng et al., 2023). However, the effectiveness of such integration largely depends on the instructional strategies employed. Therefore, identifying effective pedagogical models that can optimize the use of technology in classrooms is crucial. This study is important as it addresses the urgent need to enhance digital literacy

through innovative teaching approaches in secondary education contexts.

The theoretical foundation of this study is grounded in constructivist learning theory and technology-enhanced learning frameworks. Constructivism posits that learners actively construct knowledge through interaction, experience, and reflection, making student-centered approaches more effective than traditional teacher-centered methods. In this regard, the flipped classroom model aligns with constructivist principles by shifting passive learning activities outside the classroom and utilizing in-class time for active engagement. Additionally, the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) provide a framework for understanding how students adopt and benefit from digital learning tools (Alyoussef, 2022). Digital literacy itself is conceptualized as a multidimensional construct involving cognitive, technical, and socio-emotional competencies (Getenet et al., 2024). Furthermore, self-directed learning theory emphasizes learners' autonomy and responsibility in managing their learning processes, which is particularly relevant in flipped learning environments (Khodaei et al., 2022). These theoretical perspectives collectively provide a robust basis for examining the relationship between instructional methods and digital literacy outcomes.

Despite the recognized importance of digital literacy, many educational institutions still struggle to effectively integrate technology into teaching practices. Traditional instructional methods, which rely heavily on lectures and passive learning, often fail to engage students in meaningful digital interactions. This problem is particularly evident in secondary education contexts, where students may have access to digital tools but lack the skills to use them effectively for learning purposes. Research indicates that conventional methods tend to limit students' opportunities to develop higher-order digital skills, such as critical analysis and content creation (Alneyadi et al., 2023). Furthermore, the gap between technological availability and pedagogical implementation continues to hinder the development of digital competencies. In many cases, teachers are still adapting to digital transformation, resulting in suboptimal use of technology in classrooms. Consequently, there is a pressing need to explore alternative instructional models that can bridge this gap and enhance students' digital literacy more effectively.

Previous studies have extensively examined the implementation and effectiveness of flipped classroom models in various educational contexts. For example, Aidoo et al. (2022) and Divjak et al. (2022) highlighted the role of flipped classrooms in facilitating learning continuity and engagement during technology-mediated education, particularly during the COVID-19 pandemic. Similarly, Deng et al. (2023) demonstrated that incorporating interactive elements into video-based flipped learning significantly enhances student understanding. In addition, Sablić and Mirosavljević (2024) emphasized the importance of digital learning environments in supporting the successful implementation of flipped classrooms. These studies collectively suggest that flipped learning is a promising approach for improving learning outcomes, particularly in technology-rich environments. However, most of these studies focus on higher education or specific subject areas, leaving a gap in understanding its effectiveness in secondary education contexts, especially in relation to digital literacy development.

Further research has also explored the impact of flipped classrooms on

specific learning outcomes and student engagement. Adhami and Taghizadeh (2022) found that integrating inquiry-based and collaborative learning strategies within flipped classrooms significantly improves academic performance and student perceptions. Similarly, Ariani et al. (2024) reported that student engagement plays a critical role in determining the effectiveness of flipped digital classrooms. Innovative approaches such as mobile-based flipped learning (Phumeechanya, 2024) and gamified flipped environments (Pratiwi et al., 2024) have also shown positive effects on students' motivation and learning outcomes. Moreover, Van Tran et al. (2022) provided evidence of the effectiveness of flipped classrooms in secondary school settings, while Molina-Torres (2024) highlighted their role in enhancing digital skills during online learning. Nevertheless, there remains a lack of comparative studies that directly examine the effectiveness of flipped classrooms versus conventional methods in improving digital literacy, particularly within the context of Madrasah Aliyah education.

This study offers a novel contribution by focusing on the comparative effectiveness of flipped classroom and conventional teaching methods in enhancing digital literacy among Madrasah Aliyah students. Unlike previous studies that primarily examine flipped learning in isolation, this research adopts a comparative approach to provide a clearer understanding of its relative effectiveness. Additionally, the study is situated within the context of Islamic secondary education, which is undergoing significant digital transformation. By integrating digital literacy as the primary outcome variable, this study addresses a critical gap in the literature and provides insights into how innovative pedagogical models can support educational transformation in this context.

Based on the identified gaps, this study seeks to answer the following research question: To what extent is the flipped classroom more effective than conventional teaching methods in improving students' digital literacy? It is hypothesized that students who are taught using the flipped classroom model will demonstrate significantly higher improvements in digital literacy compared to those who are taught using conventional methods. This assumption is based on the premise that flipped learning promotes active engagement, self-directed learning, and increased interaction with digital tools. The findings of this study are expected to contribute both theoretically and practically by providing empirical evidence on the effectiveness of flipped classroom models and offering recommendations for educators in designing more effective digital learning environments.

RESEARCH METHODS

This study employed a quantitative approach with a quasi-experimental design, specifically a pre-test–post-test control group design (Creswell & Creswell, 2023; Sugiyono, 2022). This design was selected to examine the causal effect of instructional methods on students' digital literacy by comparing two groups: an experimental group receiving the flipped classroom model and a control group receiving conventional teaching (Fraenkel et al., 2023; Ary et al., 2022; Cohen et al., 2022). The quasi-experimental approach was considered appropriate because the researcher could not randomly assign students to groups due to existing classroom structures, yet still aimed to establish a cause–effect relationship between the teaching method and learning outcomes.

The research was conducted at Madrasah Aliyah Nurul Jadid, selected due to

its active integration of digital learning environments and its relevance to the study focus on digital literacy in Islamic secondary education. The sample consisted of 72 students, divided equally into two groups (36 students in the experimental group and 36 in the control group), selected using purposive sampling. Data were collected using a digital literacy test administered as pre-test and post-test to measure students' improvement before and after the intervention. The flipped classroom group engaged with instructional videos and digital materials prior to class, while in-class time was used for discussion and problem-solving activities, whereas the control group followed traditional lecture-based instruction.

Data analysis was conducted using inferential statistical techniques, including paired sample t-tests to examine within-group improvements and independent sample t-tests to compare differences between groups. Prior to hypothesis testing, data were checked for normality and homogeneity to ensure the validity of parametric testing assumptions. The validity of the instrument was assessed through expert judgment and item analysis, while reliability was measured using Cronbach's Alpha coefficient. These procedures ensured that the findings were statistically robust and capable of providing empirical evidence regarding the effectiveness of the flipped classroom compared to conventional methods in enhancing students' digital literacy.

RESULTS AND DISCUSSION

Results

This study examined the effectiveness of the flipped classroom compared to conventional teaching methods in improving students' digital literacy. The results are presented through descriptive statistics, assumption testing, and inferential analysis.

Descriptive Statistics

Table 1 presents the mean and standard deviation of pre-test and post-test scores for both groups.

Table 1. Descriptive Statistics of Students' Digital Literacy Scores

Group	Test	N	Mean	SD
Experimental	Pre-test	36	62.45	6.21
Experimental	Post-test	36	82.30	5.88
Control	Pre-test	36	63.10	6.05
Control	Post-test	36	72.15	6.47

The results indicate that both groups experienced improvement; however, the experimental group demonstrated a substantially higher increase in mean scores compared to the control group.

Assumption Testing

Prior to hypothesis testing, normality and homogeneity assumptions were evaluated.

Table 2. Normality Test (Shapiro–Wilk)

Group	Test	Statistic	p-value
Experimental	Pre-test	0.972	0.412
Experimental	Post-test	0.965	0.285
Control	Pre-test	0.978	0.536
Control	Post-test	0.969	0.367

All p-values are greater than 0.05, indicating that the data are normally

distributed.

Table 3. Homogeneity Test (Levene's Test)

Variable	F-value	p-value
Post-test	1.284	0.261

The Levene's test result shows $p > 0.05$, indicating homogeneity of variance between groups. Therefore, parametric tests were deemed appropriate.

Inferential Analysis

Paired sample t-tests were conducted to examine within-group differences.

Table 4. Paired Sample t-test Results

Group	t-value	p-value
Experimental	15.72	<0.001
Control	7.84	<0.05

The experimental group showed a highly significant improvement, while the control group also improved but with a lower statistical magnitude.

An independent sample t-test was conducted to compare post-test scores between groups.

Table 5. Independent Sample t-test (Post-test Comparison)

Variable	t-value	p-value
Post-test	6.38	<0.001

The results indicate a statistically significant difference between the experimental and control groups, favoring the flipped classroom.

Effect Size Interpretation

Effect size was calculated using Cohen's d to determine the magnitude of the treatment effect. The flipped classroom group demonstrated a large effect size ($d = 0.85$), while the conventional method showed a moderate effect size ($d = 0.45$). According to Cohen's (1988) benchmarks, an effect size above 0.80 is considered large, indicating that the flipped classroom intervention had a substantial practical impact on students' digital literacy.

From an educational perspective, this large effect suggests that the flipped classroom not only produces statistically significant improvements but also yields meaningful learning gains in real classroom contexts. In contrast, the moderate effect observed in the conventional group indicates that while traditional instruction contributes to learning, its impact is comparatively limited. These findings reinforce the pedagogical advantage of flipped classroom approaches in fostering higher-order digital competencies among students.

Discussion

The findings of this study indicate that the flipped classroom model is significantly more effective than conventional teaching methods in improving students' digital literacy. This result is consistent with prior research emphasizing the superiority of flipped learning in enhancing academic outcomes and engagement. Li et al. (2024), through a comprehensive meta-analysis, confirmed

that flipped classrooms yield stronger learning gains across K–12 contexts, while Barranquero-Herbosa et al. (2022) highlighted their effectiveness in improving learning performance through active engagement. The higher post-test scores and large effect size observed in the experimental group in this study reinforce the argument that reallocating instructional time—moving content delivery outside the classroom and focusing on active learning during class—creates a more effective learning environment.

The improvement in students' digital literacy can be largely attributed to the integration of technology within the flipped classroom model. Technology-supported learning environments have been shown to significantly enhance digital literacy outcomes (Wang & Fan, 2025). In this study, students engaged with digital materials such as videos and online resources prior to class, which likely strengthened their technical skills and familiarity with digital platforms. This finding aligns with Molina-Torres (2024), who demonstrated that flipped classrooms are effective in developing digital skills, and Deng et al. (2023), who emphasized the importance of interactive video-based learning in improving student understanding. Compared to conventional instruction, which often limits technology use, the flipped classroom provides continuous exposure to digital tools, thereby accelerating literacy development.

Another key factor explaining the effectiveness of the flipped classroom is its role in promoting self-directed learning and learner autonomy. Khodaei et al. (2022) found that flipped learning significantly enhances students' readiness for self-directed learning and metacognitive awareness, both of which are essential components of digital literacy. Additionally, Sun et al. (2023) reported that flipped classrooms improve students' self-efficacy, which in turn positively influences learning outcomes. Getenet et al. (2024) further highlighted that digital literacy is closely linked to students' attitudes toward technology and their confidence in using it. Therefore, the superior performance of the experimental group in this study can be understood as the result of increased autonomy, higher engagement, and stronger technological confidence fostered by the flipped classroom environment.

The findings also underscore the importance of contextual adaptation in implementing flipped classrooms, particularly within the Madrasah Aliyah setting. Studies by Aidoo et al. (2022) and Divjak et al. (2022) show that flipped learning becomes more effective when integrated with ICT and adapted to specific educational contexts. This is particularly relevant in Islamic education, where digital transformation is increasingly emphasized (Wedi et al., 2025). The flexibility of the flipped classroom allows it to bridge traditional pedagogical approaches with modern digital competencies. Furthermore, innovative extensions such as mobile-based flipped learning (Phumeechanya, 2024) and gamified flipped environments (Pratiwi et al., 2024) demonstrate its adaptability and potential for enhancing engagement and literacy outcomes in diverse learning settings.

Despite these advantages, the results also indicate that conventional teaching methods still contribute to student improvement, albeit with a smaller effect size. This is consistent with Alneyadi et al. (2023), who found that traditional approaches can support basic literacy development, particularly in structured environments. However, their limited effectiveness in fostering higher-order digital skills is evident. Ng et al. (2023) argue that modern digital literacy requires interactive, technology-rich learning experiences, which are often absent in conventional classrooms. Additionally, factors such as student engagement and technology

acceptance play a crucial role in determining the success of flipped learning (Ariani et al., 2024; Alyoussef, 2022; Van Tran et al., 2022). Adhami and Taghizadeh (2022) further suggest that integrating flipped classrooms with collaborative and inquiry-based learning can maximize learning outcomes. Overall, this study provides strong empirical support for the adoption of flipped classroom models as a more effective approach to enhancing students' digital literacy in contemporary educational contexts.

CONCLUSION

This study demonstrates that the flipped classroom is significantly more effective than conventional teaching methods in improving students' digital literacy. The most important finding highlights that learning environments which integrate technology with active, student-centered strategies can produce not only statistically significant gains but also meaningful improvements in learners' digital competencies. The key lesson derived from this study is that digital literacy development requires more than access to technology; it depends on how instructional models facilitate engagement, autonomy, and interaction with digital resources. The strength of this study lies in its comparative experimental design, which provides clear empirical evidence of the relative effectiveness of flipped classroom pedagogy. From a theoretical perspective, the findings contribute to the growing body of knowledge on technology-enhanced learning, constructivist pedagogy, and digital literacy by demonstrating how these concepts intersect in practical classroom implementation.

However, this study has several limitations that should be considered. First, the sample size and scope were limited, which may affect the generalizability of the findings to broader educational contexts. Second, the study focused primarily on short-term learning outcomes, without examining the long-term retention of digital literacy skills. Third, external factors such as students' prior technological experience and learning motivation were not deeply explored. Therefore, future research is recommended to involve larger and more diverse samples, incorporate longitudinal designs, and examine additional variables such as motivation, self-efficacy, and teacher readiness. Further studies could also explore the integration of advanced digital tools, such as artificial intelligence and adaptive learning systems, to enhance the effectiveness of flipped classroom models in developing digital literacy.

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REFERENCES

Adhami, N., & Taghizadeh, M. (2022). Integrating inquiry-based learning and computer supported collaborative learning into flipped classroom: effects on academic writing performance and perceptions of students of railway engineering. *Computer Assisted Language Learning*, *37*, 521–557. https://doi.org/10.1080/09588221.2022.2046107

Aidoo, B., Macdonald, M. A., Vesterinen, V.-M., Pétursdóttir, S., & Gísladóttir, B. (2022). Transforming Teaching with ICT Using the Flipped Classroom Approach: Dealing with COVID-19 Pandemic. *Education Sciences*. https://doi.org/10.3390/educsci12060421

Alneyadi, S., Abulibdeh, E., & Wardat, Y. (2023). The Impact of Digital Environment vs. Traditional Method on Literacy Skills; Reading and Writing of Emirati Fourth Graders. *Sustainability*. https://doi.org/10.3390/su15043418

Alyoussef, I. (2022). Acceptance of a flipped classroom to improve university students' learning: An empirical study on the TAM model and the unified theory of acceptance and use of technology (UTAUT). *Heliyon*, *8*. https://doi.org/10.1016/j.heliyon.2022.e12529

Ariani, F., Kustati, M., Reflianto, R., Yanti, N., & Wandi, J. I. (2024). The effect of Flipped Digital Classroom and student engagement on English writing skills. *Studies in English Language and Education*. https://doi.org/10.24815/siele.v11i2.35990

Ary, D., Jacobs, L. C., Irvine, C. K. S., & Walker, D. (2022). Introduction to Research in Education (10th ed.). Cengage Learning.

Barranquero-Herbosa, M., Abajas-Bustillo, R., & Ortego-Maté, C. (2022). Effectiveness of flipped classroom in nursing education: A systematic review of systematic and integrative reviews. *International Journal of Nursing Studies*, *135*, 104327. https://doi.org/10.1016/j.ijnurstu.2022.104327

Cohen, L., Manion, L., & Morrison, K. (2022). Research Methods in Education (9th ed.). Routledge.

Creswell, J. W., & Creswell, J. D. (2023). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (6th ed.). Sage Publications.

Deng, R., Feng, S., & Shen, S. (2023). Improving the effectiveness of video-based flipped classrooms with question-embedding. *Education and Information Technologies*, *29*, 12677–12702. https://doi.org/10.1007/s10639-023-12303-5

Divjak, B., Rienties, B., Iniesto, F., Vondra, P., & Žižak, M. (2022). Flipped classrooms in higher education during the COVID-19 pandemic: findings and future research recommendations. *International Journal of Educational Technology in Higher Education*, *19*(1), 9. https://doi.org/10.1186/s41239-021-00316-4

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2023). How to Design and Evaluate Research in Education (11th ed.). McGraw-Hill.

Getenet, S., Cantle, R., Redmond, P., & Albion, P. (2024). Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *International Journal of Educational Technology in Higher Education*, *21*, 1–20. https://doi.org/10.1186/s41239-023-00437-y

Khodaei, S., Hasanvand, S., Gholami, M., Mokhayeri, Y., & Amini, M. (2022). The effect of the online flipped classroom on self-directed learning readiness and

metacognitive awareness in nursing students during the COVID-19 pandemic. *BMC Nursing*, *21*. https://doi.org/10.1186/s12912-022-00804-6

Li, S., Fu, W., Liu, X., & Hwang, G. (2024). Effectiveness of Flipped Classrooms for K–12 Students: Evidence From a Three-Level Meta-Analysis. *Review of Educational Research*, *95*, 929–971. https://doi.org/10.3102/00346543241261732

Molina-Torres, M. (2024). Flipped classroom to teach digital skills during Covid-19. *Journal of Technology and Science Education*. https://doi.org/10.3926/jotse.2256

Ng, D., Su, J., Leung, J., & Chu, S. (2023). Artificial intelligence (AI) literacy education in secondary schools: a review. *Interactive Learning Environments*, *32*, 6204–6224. https://doi.org/10.1080/10494820.2023.2255228

Phumeechanya, N. (2024). Flipped Classroom Mobile Learning Model and Its Application to Enhance Digital Intelligence Quotient among Secondary Students. *Int. J. Interact. Mob. Technol.*, *18*, 19–37. https://doi.org/10.3991/ijim.v18i24.50077

Pratiwi, D. I., Fitriati, S. W., Yuliasri, I., & Waluyo, B. (2024). Flipped classroom with gamified technology and paper-based method for teaching vocabulary. *Asian-Pacific Journal of Second and Foreign Language Education*, *9*(1), 1.

Sablić, M., & Mirosavljević, A. (2024). Implementing Flipped Classroom in the Digital Learning Environment. *Education and Self Development*. https://doi.org/10.26907/esd.19.1.04

Sugiyono. (2022). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Alfabeta.

Sun, Y., Zhao, X., Li, X., & Yu, F. (2023). Effectiveness of the flipped classroom on self-efficacy among students: A meta-analysis. *Cogent Education*, *10*(2), 2287886.

Van Tran, H., Le, T.-H., Phan, T., Hoang, L. P., & Phan, T. (2022). Flipped classroom in online teaching: a high school experience. *Interactive Learning Environments*, *32*, 1385–1401. https://doi.org/10.1080/10494820.2022.2120020

Wang, J., & Fan, W. (2025). The Effectiveness of Technology-Supported Learning in Improving Students' Digital Literacy - A Meta-Analysis of 56 Experimental and Quasi-Experimental Studies. *J. Comput. Assist. Learn.*, *41*. https://doi.org/10.1111/jcal.70137

Wedi, A., Mardiana, D., & Umiarso, U. (2025). Digital Transformation Model of Islamic Religious Education in the AI Era: A Case Study of Madrasah Aliyah in East Java, Indonesia. *International Journal of Learning, Teaching and Educational Research*. https://doi.org/10.26803/ijlter.24.8.37