



A practical life based digital literacy framework for preservice teachers' digital transformation

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Article info	Abstract
Keywords: digital literacy, practical life, preservice teacher, digital literacy framework	The rapid digital transformation in preservice teacher education requires future teachers not only to use digital technologies but also to design innovative learning practices that address real-world educational needs. However, many programs still emphasize technical skills rather than the meaningful integration of digital competencies into authentic professional contexts. This study aims to examine how digital literacy is developed among preservice teachers in Islamic higher education institutions and to formulate a practical-life-based digital literacy framework to support their digital transformation. A qualitative multiple case study was conducted at two Indonesian Islamic universities. Data were collected through semi-structured interviews with faculty leaders and program administrators, analysis of curriculum documents, student digital portfolios, and observations of technology-enhanced learning environments. Data analysis followed an interactive model and thematic analysis supported by NVivo to ensure systematic coding and interpretation. The findings reveal that digital literacy development is shaped by institutional policy, curriculum integration, and practical-life-based learning activities, forming a digital ecosystem that transforms preservice teachers into innovative and reflective digital practitioners.

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1. Introduction

Digital literacy has become a core competency that teachers must possess in the twenty-first century (Hidayati et al., 2022; Marín & Castañeda, 2023; Oktarina et al., 2025). In this context, digital literacy can no longer be viewed merely as a complementary skill but rather as a fundamental capacity for maintaining epistemic integrity in the learning process (Aleksieva, 2025; Crompton & Burke, 2023; Iskandar et al., 2025; Rahmayani et al., 2025). The uncontrolled circulation of digital content, including misinformation and disinformation that can easily permeate educational practices, requires teachers to possess critical and evaluative digital competencies (Bruno et al., 2025; OECD, 2019; UNESCO, 2021). Although awareness of the importance of digital literacy continues to increase, its implementation in teacher education programs is still frequently conceptualized and carried out predominantly through technical and functional approaches (Hasanah et al., 2024; Hayati & Widodo, 2025; Mastiah et al., 2026; Tondeur et al., 2025), with limited emphasis on the critical interpretation of digital information (Chen et al., 2025; Zhang et al., 2026). In response to these challenges, Islamic higher education institutions in Indonesia have undertaken several strategic initiatives, including curriculum development and the strengthening of technology-based educational quality assurance systems (Ma'sum & Khuriyah, 2025).

However, curriculum revision alone does not automatically guarantee the achievement of transformational learning outcomes. Evidence from higher education studies indicates that effective digital literacy development strongly depends on a systemic ecosystem (Barrios-del-ángel et al., 2026) consisting of four interconnected elements: (1) digital technical competence (Barrios-del-ángel et al., 2026; Cohen et al., 2022), (2) alignment with real-world and professional contexts (Basilotta-Gómez-Pablos et al., 2022; Farias-gaytan & Aguaded, 2023), (3) the implementation of project-based and experiential learning models (Mufaridah et al., 2025), and (4) continuous evaluation of digital learning products and academic workload. Without institutional coherence among these elements, digital literacy initiatives risk becoming merely technical training disconnected from meaningful academic practice.

Within this context, learning approaches that connect digital competence with authentic professional practice are increasingly important. This study proposes a Practical Life-Based Digital Literacy (DLPL) design, a pedagogical approach that situates digital competence within the creation of contextual learning outputs aligned with real teaching tasks. Unlike Montessori's practical life activities, which emphasize children's independence and daily living skills, practical life in this study refers to authentic professional engagement in which preservice teachers use digital technologies to address educational challenges, design learning resources, and develop instructional innovations. Consistent with authentic and experiential learning theories (Rasheed et al., 2020), the DLPL model positions digital competence as a means of producing pedagogically meaningful outputs. Its implementation at UIN Sayyid Ali Rahmatullah Tulungagung and UIN Syekh Wasil Kediri demonstrated transformative growth in students' digital competencies, enabling them to integrate AI tools, digital media platforms, and collaborative technologies into instructional products. These outcomes reflect the emergence of a digital literacy ecosystem supported by curriculum reform, institutional vision, infrastructure, and non-formal enrichment programs.

This study contributes new insights to the digital literacy literature. Previous research on digital transformation has largely focused on digital competencies, technostress, and faculty well-being, while the impact of digital learning innovations on academic workload efficiency and redistribution remains underexplored (Buda et al., 2024; Gorrell, 2023). Recent studies have explored teachers' digital competence, technology integration, and pedagogical applications of

digital technologies in education (Alptekin & Taneri, 2025; Basilotta-Gómez-Pablos et al., 2022; Kurniaman & Firdaus, 2022; Purnamasari et al., 2022; Wildan et al., 2022; Yang et al., 2022). These frameworks have advanced understanding of teachers' digital skills, technology-enhanced pedagogy, and professional development. However, they primarily emphasize competence acquisition and technology integration, with limited attention to the application of digital literacy in authentic professional practices and the creation of tangible learning products. As a result, the interplay among institutional policy, curriculum integration, and practical-life-oriented learning in shaping preservice teachers' digital transformation remains insufficiently understood.

Addressing this gap requires a structured and theoretically grounded model that integrates curriculum policy (Zhou et al., 2025), pedagogical strategies, and institutional governance (Farias-gaytan & Aguaded, 2023) within a coherent educational ecosystem. Therefore, this study investigates how digital literacy is developed through authentic professional practices in Islamic higher education and proposes the Digital Literacy based on Practical Life (DLPL) framework to support preservice teachers' digital transformation.

2. Method

2.1. Research design

This study employed a qualitative, multiple-case study design to explore how digital literacy competencies are developed in Islamic higher education institutions in Indonesia. Grounded in an interpretive paradigm, the study examines institutional strategies, pedagogical practices, and contextual factors shaping students' progression from digital competence to digital transformation. This approach enables a holistic understanding of how digital literacy is conceptualized and operationalized within curriculum policies and learning practices (Creswell & Creswell, 2018).

2.2. Research sites and participants

The research was conducted at two Islamic universities that adopted different approaches to digital literacy development. One institution offers digital literacy as a compulsory university-level course, while the other integrates it into practice-based courses at the program level. The sites were purposively selected due to their curriculum restructuring in response to national education policies and digital transformation initiatives. Participants were purposively recruited to represent key stakeholders involved in curriculum development and in the implementation of digital literacy. Participants included faculty leaders, curriculum coordinators, and student representatives involved in technology-enhanced learning activities. Data were collected through semi-structured interviews conducted both face-to-face and online (45–90 minutes), classroom observations during project-based learning activities, and analysis of curriculum structures, course syllabi, and institutional policy documents. The use of multiple data sources enabled triangulation and supported the development of the Practical Life-Based Digital Literacy (PLDL) framework.

2.3. Data collection

Data were collected through triangulated qualitative methods, including semi-structured interviews, analysis of curriculum documents, student digital portfolios, and classroom observations. Interviews explored institutional policies, curriculum integration strategies, and the implementation of practical-life-based digital learning. Curriculum documents were analyzed to identify shifts in the positioning of digital literacy within academic policies. Student

digital products were examined to capture indicators of digital transformation, while classroom observations focused on the implementation of technology-enhanced and project-based learning practices.

2.4. Data analysis

Data were analyzed using thematic analysis to identify patterns and relationships across data sources (Nowell et al., 2017). The process involved coding, categorizing, and interpreting data related to institutional policy, curriculum integration, and digital learning practices. This analysis follows qualitative procedures that emphasize systematic data organization, coding, and interpretation (Miles, Matthew B.). NVivo 12 was employed to support systematic data management, coding, pattern identification, and the development of analytical themes, thereby enhancing the transparency and traceability of the analytical process. To ensure trustworthiness, methodological triangulation across multiple data sources was conducted, and member checking with selected participants was undertaken to verify the accuracy of interpretations and emerging findings.

3. Results

Based on a thematic analysis of interview data, curriculum documents, and classroom observations, this study identified several patterns that illustrate how digital literacy is developed within the teacher education ecosystem in Islamic higher education institutions. The coding and categorization processes yielded several major themes that capture the relationships among institutional policy, instructional practices, and the development of students' digital competencies. The analysis revealed three principal themes: (1) institutional policies for strengthening digital literacy, (2) the integration of digital literacy in curriculum and learning processes, and (3) the implementation of practical-life-based learning.

3.1. Institutional policies for strengthening digital literacy

Strengthening digital literacy at the institutional level serves as a fundamental foundation for building an educational ecosystem responsive to technological transformation. The findings show that digital literacy is not merely positioned as a technical skill but has been integrated into academic policy as a strategic component supporting learning transformation. Its development is implemented not only through classroom practices but also through institutional policies related to curriculum design, digital infrastructure, and capacity-building programs.

This orientation is reflected in institutional leadership perspectives. The Vice Dean for Academic Affairs at UIN Sayyid Ali Rahmatullah Tulungagung emphasized:

"The institutional vision clearly demonstrates the university's commitment to strengthening students' digital literacy skills, as stated in the strategic plan."

In contrast, at UIN Syekh Wasil Kediri, digital literacy is not explicitly stated but implicitly embedded within scientific development, as noted:

"Although the wording does not explicitly use the term digital literacy, it is implicitly included within the broader discourse of science."

Despite these differences, both institutions translate their visions into policies. As stated:

"Digital literacy is implemented through the curriculum as a compulsory course and supported by various programs" (UIN Tulungagung)

"The policy is reflected in curriculum integration and institutional strategic planning to strengthen digital literacy" (UIN Kediri)

The statements from both informants indicate that digital literacy has become part of the strategic agenda for academic development at both institutions, although it is implemented through different policy approaches. These findings suggest that digital literacy strengthening is not limited to classroom practices but has been integrated into the structure of academic policy and institutional planning.

To further strengthen the interpretation of these interview findings, the analysis was deepened through coding and thematic mapping in NVivo. The results of this analysis visualize the relationships among data sources, key codes, and conceptual categories emerging from interviews and institutional documents. The Visualization of this analytical result is presented in Figure 1.

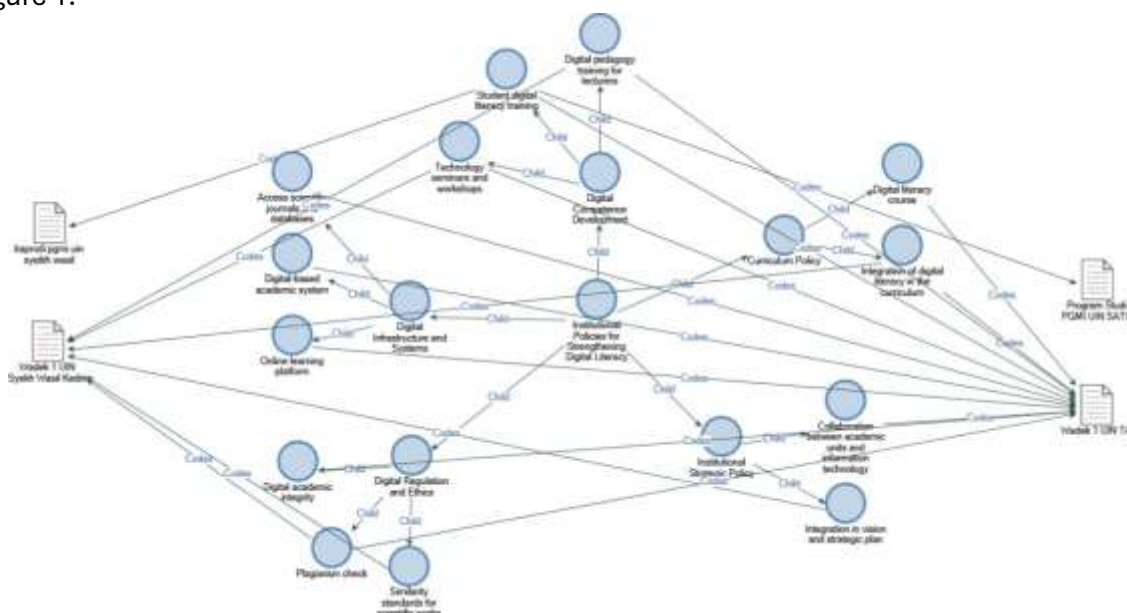


Figure 1. Interview analysis of institutional policy

Figure 1 presents a relational map derived from NVivo coding. This Visualization illustrates the relationships between interview data sources and various policy themes emerging from the analysis. The main nodes represent policy categories related to strengthening digital literacy at the institutional level, while the connections between nodes indicate conceptual relationships among strategic policies, curriculum implementation, digital competency development, and academic regulations that support the digital literacy ecosystem.

The thematic map shows that digital literacy strengthening in both institutions is not realized through a single specific policy but rather develops across several interconnected policy dimensions. These dimensions include integrating digital literacy into the curriculum through digital literacy courses, strengthening digital infrastructure and systems, such as online learning platforms and digital academic systems, and developing digital competency through training, seminars, and technology workshops for both lecturers and students. In addition, regulatory aspects emerge as an important component of the digital literacy ecosystem, reflected in policies on digital ethics, plagiarism detection, and academic work similarity standards. These findings indicate that digital literacy in both institutions has evolved from a mere technical skill to a more systemic policy framework. Digital literacy is not only present as a classroom practice but

has been integrated into academic governance, human resource capacity development, and academic regulations governing the use of technology within higher education environments.

Furthermore, the findings reveal that implementing practical-life-based digital literacy cannot be separated from the curriculum's role as a fundamental foundation for preservice teacher education. Therefore, the following section discusses more specifically how digital literacy is integrated into the curriculum and how this integration contributes to the development of a digital learning ecosystem at the study program level.

3.2. Integration of digital literacy in curriculum and learning

The integration of digital literacy into the curriculum operationalizes institutional policies at the strategic level. The findings indicate that both Islamic higher education institutions have undergone curriculum reforms between 2020 and 2025 in response to national education policies, particularly *Permendikbudristek* No. 53 of 2023, as well as rapid technological advancements. Analysis of curriculum documents reveals two major revisions reflecting a shift from viewing technology merely as a learning support tool toward integrating digital literacy as a core component of prospective teachers' pedagogical competencies. This transformation is evident through three phases of curriculum development, illustrating a gradual progression toward more structured and meaningful integration of digital literacy within teacher education programs.

At the Faculty of Tarbiyah and Teacher Training of UIN Sayyid Ali Rahmatullah Tulungagung and UIN Syekh Wasil Kediri, three phases of curriculum transformation can be identified: The relevant data are presented in Table 1.

Table 1. Phases of curriculum transformation

Institution	Curriculum	Cohort	Position of Digital Literacy
UIN Sayyid Ali Rahmatullah Tulungagung	2020	2020–2021	Integrated within Educational Technology
UIN Sayyid Ali Rahmatullah Tulungagung	2022	2022–2023	Intrinsically integrated
UIN Sayyid Ali Rahmatullah Tulungagung	2024	2024–present	Standalone course (university-level compulsory course across programs)
UIN Syekh Wasil Kediri	2021	2021–2022	Integrated within practice-oriented courses
UIN Syekh Wasil Kediri	2023	2023–2024	Strengthening of Digital Learning Media practices
UIN Syekh Wasil Kediri	2025	2025–present	Digital literacy and product-based innovation

The most significant change in the 2024 curriculum at UIN Sayyid Ali Rahmatullah Tulungagung lies in the repositioning of digital literacy from an *embedded competence* to a *standalone institutional competence*. In the previous curricula (2020 and 2022), digital literacy was intrinsically integrated into the Educational Technology course. Within this configuration, digital literacy was understood as a pedagogical skill inherent in prospective teachers' competencies in designing media, teaching materials, learning resources, and instructional strategies.

However, in the 2024 curriculum, digital literacy was made compulsory at the university level across all study programs. By positioning it as a university course, digital literacy became part of the university-level curriculum planning scheme. Consequently, the credit allocation for the digital literacy course is determined by the university's curriculum development team, totaling 2

credit units (2 credits). In contrast to the structural model implemented at UIN Sayyid Ali Rahmatullah Tulungagung, UIN Syekh Wasil Kediri maintains a practice-based approach. Digital literacy is not taught as an independent university course but is embedded in courses directly related to media production and learning innovation, such as Digital Learning Media, Learning Innovation, and Educational Business Innovation.

The approach to strengthening digital literacy at UIN Syekh Wasil Kediri is therefore not delivered as an isolated theoretical concept but is developed through authentic production activities, including the creation of learning media, digital applications, educational content, and edupreneurship products. This integration is contextualized according to the disciplinary identity of each study program. In the PGMI program, digital literacy strengthening focuses on developing learning media for elementary-level madrasah students, while in the PAI program, it is directed toward innovation in religious education and the development of educational entrepreneurship potential. The *learning-by-doing* orientation is evident in project-based assignments that require students to operationalize digital literacy frameworks through reflective and experimental practices. As a result, competencies are developed through direct experiential engagement rather than solely through theoretical understanding.

3.3. Implementation of practical-life-based learning

Based on interviews with study program administrators and the analysis of student portfolios at both UIN Sayyid Ali Rahmatullah Tulungagung and UIN Syekh Wasil Kediri, the findings indicate that the implementation of digital literacy in learning has been directed toward a practical-life-based approach. This approach positions digital technology not merely as a technical tool but as a medium for developing students' abilities to design learning solutions that are relevant to real needs in madrasah or school environments. Through various project-based assignments, students are encouraged to integrate pedagogical competencies with digital technologies to produce contextual, applicable learning products.

The results of the interview analysis regarding the implementation of practical-life-based learning are visualized in the coding relationship network presented in Figure 2.

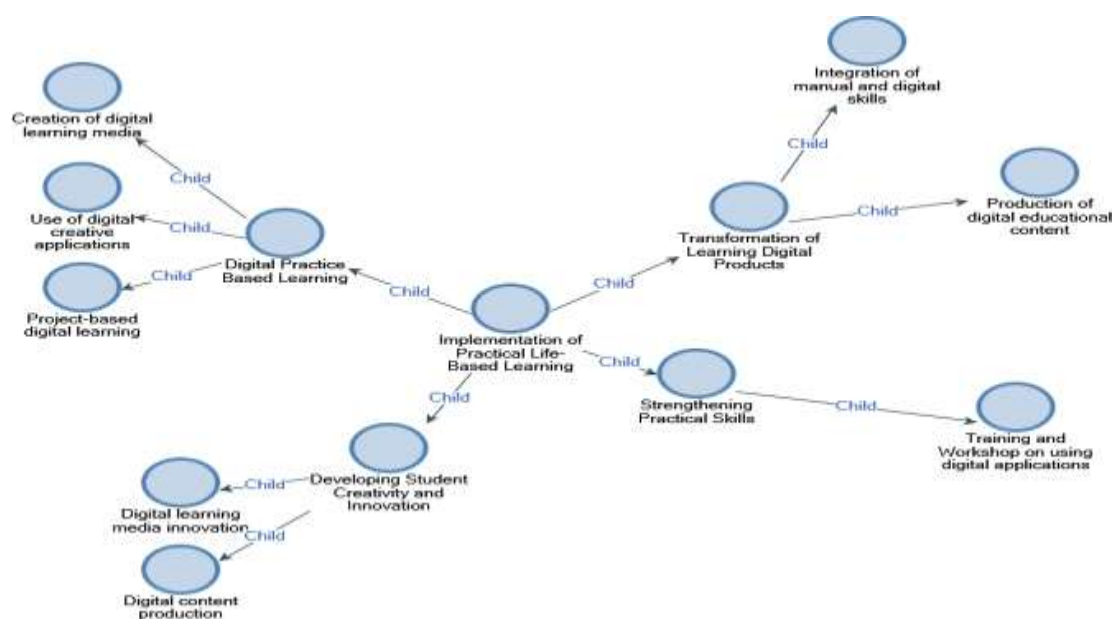


Figure 2. Interview analysis of dlpl implementation

Figure 2 illustrates a coding relationship network derived from qualitative data analysis that maps the relationships among data sources, initial codes, conceptual categories, and research themes. The coding process shows that digital project-based learning practices, the use of creative applications, and the development of digital learning media are closely connected to the implementation of practical-life-based learning. These relationships subsequently contribute to the development of student creativity and innovation in digital learning media and to the production of technology-based educational content.

These findings are further reinforced by the analysis of student portfolios, which indicates that students' digital literacy abilities are no longer limited to the stages of digital usage (basic technology use) or digital competence (technical skill mastery), but have begun to demonstrate characteristics of digital transformation. This transformation is reflected in students' abilities to design, modify, and produce a range of innovative, context-specific digital products. Portfolio data show that students are capable of developing barcode-based learning applications, Javanese vocabulary flashcards, and digital product marketing strategies through online marketplaces.

The following examples illustrate several student portfolio products utilizing digital technology:



Figure 3. Student product portfolio

Figure 3 presents several examples of learning products developed by students through a practical-life-based learning approach that integrates printed media with digital technologies. These products include QR-code-based learning media, interactive learning tools such as vocabulary flashcards, and educational products marketed through digital marketplace platforms. The presence of QR codes across various learning media demonstrates students' efforts to connect physical teaching materials with online learning resources, thereby expanding their learning experiences. Meanwhile, product marketing on digital marketplaces suggests that students are not only capable of creating technology-based learning media but are also beginning to develop digital entrepreneurship skills by distributing educational products to a broader community.

These findings suggest that students' digital literacy is not solely focused on technological mastery but also on the ability to produce innovative learning products with educational value and practical applicability in educational environments. The products developed by students

demonstrate that the learning process has encouraged them to connect pedagogical competencies, media design creativity, and the use of digital platforms to generate learning solutions relevant to the needs of schools or madrasahs.

Digital literacy in this context evolves as a practice that not only produces digital learning media but also creates broader opportunities for use within the educational ecosystem. These findings provide the conceptual foundation for the development of the **Digital Literacy based on the Practical Life (DLPL)** framework. This conceptual framework is subsequently formulated into a practical-life-based digital literacy model, which is described in the following section.

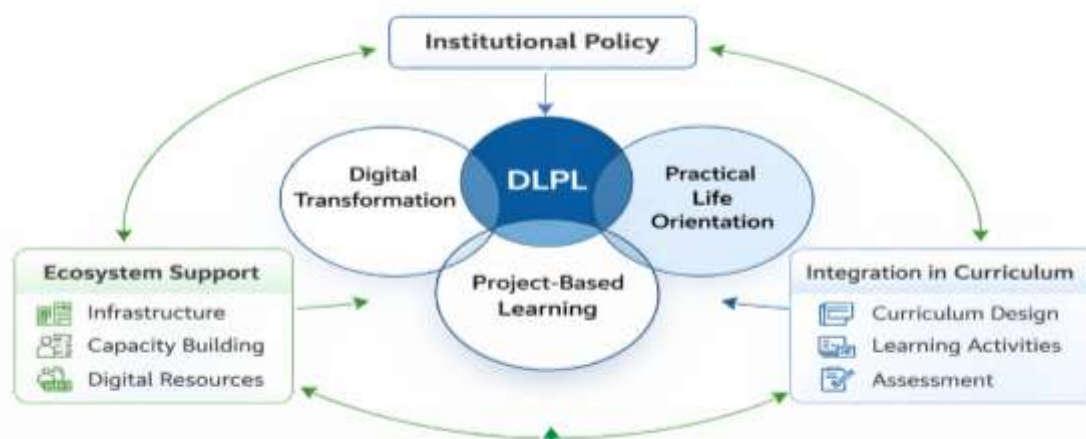


Figure 4. Digital literacy framework based on practical life (DLPL)

Figure 4 presents the Digital Literacy based on Practical Life (DLPL) framework, which conceptualizes students' digital literacy as the result of interactions among key dimensions within the higher education ecosystem. At its core, DLPL integrates three pedagogical components: digital transformation, practical-life orientation, and project-based learning. Digital transformation refers to the adaptive use of technology to solve problems and create learning products, while practical-life orientation connects digital literacy to authentic professional contexts. Project-based learning provides students with opportunities to integrate knowledge, digital skills, and practical experience through authentic projects. The DLPL framework shares several characteristics with existing ecosystem-based and project-based digital literacy models, particularly in emphasizing collaborative learning environments and authentic learning tasks. However, its contribution lies in integrating practical-life orientation with institutional policy, curriculum integration, and ecosystem support within a single framework.

While DigCompEdu and related digital competence frameworks primarily identify the knowledge, skills, and attitudes required for effective technology use, DLPL focuses on the contextual conditions through which these competencies are developed and applied. The framework, therefore, extends competence-based perspectives by incorporating institutional policy, curriculum integration, and ecosystem support as enabling factors for digital transformation. In this regard, DLPL complements rather than replaces existing digital competence frameworks by explaining how individual competencies interact with institutional and curricular environments to support authentic professional practice and the creation of meaningful educational outputs.

Beyond its pedagogical core, the DLPL framework incorporates institutional-level dimensions that shape and sustain digital literacy development. Institutional policy provides

strategic direction for digital literacy implementation, which is operationalized through curriculum integration in courses, instructional design, and academic activities. This process is further supported by ecosystem support, including technological infrastructure, training programs, workshops, and digital communities of practice. Together, these dimensions create a digital literacy ecosystem that enables students to develop digital competencies in a contextual, reflective, and sustainable manner.

4. Discussion

The findings of this study indicate that students' digital literacy practices have progressed beyond instrumental technology use to more transformative capabilities. This progression is reflected in students' abilities to design, modify, and distribute technology-based learning products that are contextualized to the needs of learning in schools or madrasahs. These characteristics are consistent with the Digital Competence Framework for Citizens, which highlights dimensions such as problem solving, digital content creation, and artificial intelligence literacy as essential competencies in digital societies (Biagini, 2025; Ferrari et al., 2013; Gu & Ericson, 2025; Philippakos & Rocconi, 2025; Vuorikari et al., 2022). In the context of higher education, digital literacy is no longer understood merely as a set of technical skills but as the capacity to use technology to create innovative solutions (Pereira et al., 2022) and to respond to the complexity of the digital ecosystem (Falloon, 2020; Redecker & Punie, 2017).

At the institutional level, curriculum changes that position digital literacy within academic policy reflect the dynamics of digital transformation in higher education. The digital transformation perspective emphasizes that institutional leadership and strategic policies are critical factors in promoting educational innovation (Castañeda & Selwyn, 2018; Mar et al., 2020). Several studies also indicate that sustainable digital transformation requires integration among curriculum policies, faculty capacity development, and the cultivation of an academic culture of innovation (OECD, 2021; Ong et al., 2021). Meanwhile, the integration of digital literacy through learning practices at the study program level demonstrates a tendency toward authentic learning and contextual digital pedagogy, in which digital competencies are developed through disciplinary practices relevant to the professional context of prospective teachers (Momdjian et al., 2025).

The implementation of project-based learning in this study highlights the important roles of Project-Based Learning (PjBL) and experiential learning in fostering students' digital literacy. Project-based learning enables students to develop creativity, digital agency, and collaborative skills within technology-enhanced learning environments (Ramadan et al., 2026; Sastrawati et al., 2025; Yusri et al., 2024; Zakiyyah et al., 2024). Furthermore, authentic learning experiences through processes of designing, reflecting on, and revising digital products contribute to the development of transformative digital learning, which not only enhances technological skills but also shapes students' ways of thinking and professional practices as future educators (Rasheed et al., 2020).

Beyond pedagogical aspects, the strengthening of digital literacy is also influenced by institutional-level support for the digital education ecosystem. Technological infrastructure, artificial intelligence training, and digital capacity-building programs for lecturers and students play an important role in strengthening technology-based learning environments. In the literature on higher education transformation, the digital education ecosystem is understood as a dynamic interaction among policies, technologies, educational actors, and organizational culture that supports learning innovation (Technol et al., 2021). This finding complements existing

frameworks such as DigCompEdu and TPACK by highlighting the importance of practical-life orientation and ecosystem support in facilitating digital transformation. The importance of ecosystem support for sustainable digital transformation has also been emphasized in previous studies (Alfred et al., 2026; Tang et al., 2025).

In this study, digital transformation is not interpreted merely as the acquisition of digital skills. Rather, it refers to a shift in students' professional practices, in which they move from being technology users to creators of technology-enhanced learning solutions. Evidence of this transformation is reflected in students' ability to design QR-based learning systems, interactive digital media, AI-supported learning resources, and educational products distributed through digital platforms. These products demonstrate not only technical proficiency in using digital tools but also students' capacity to identify educational needs, design contextually relevant learning solutions, integrate pedagogical considerations into digital products, and disseminate their innovations through broader digital networks. Such characteristics indicate a transition from operational technology use toward more reflective, creative, and professionally oriented digital practices.

5. Conclusion and implications

This study shows that digital literacy development in Islamic higher education emerges through the interaction of institutional policies, curriculum reform, and project-based learning oriented toward practical life. The findings indicate that students move beyond technology use to digital transformation by designing, adapting, and disseminating technology-enhanced learning products that address authentic educational needs. The study proposes the Digital Literacy based on Practical Life (DLPL) framework, which explains how digital competencies are developed through the interplay of project-based pedagogy, curriculum integration, institutional support, and a digital learning ecosystem. Unlike competence-focused frameworks, DLPL emphasizes the interaction between individual competencies and institutional conditions in fostering authentic professional learning experiences. Future research should examine the implementation of DLPL across diverse higher education contexts and its long-term impact on preservice teachers' professional digital competencies. In practice, the framework offers guidance to curriculum developers, teacher education programs, and institutional leaders on strengthening digital literacy through authentic, sustainable, and ecosystem-based learning experiences.

6. Limitation

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in only two Islamic higher education institutions in Indonesia, which may limit the generalizability of the results to broader higher education contexts with different institutional characteristics. Second, the qualitative case study approach emphasizes in-depth exploration of institutional policies, curriculum practices, and learning activities; therefore, the findings mainly provide interpretive insights rather than statistically generalizable conclusions. Third, the study primarily focuses on institutional policy, curriculum integration, and practical-life-based learning practices, while other potential factors, such as students' individual motivation, digital learning analytics, and long-term professional impacts, were not examined in depth.

Declaration and Statement

CRedit Authorship Contribution Statement

Uswatun Hasanah: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing original draft, Visualization. Arpinda Syifa Awal: Validation, Resources, Data curation, writing (review & editing). Annas Ribab Sibilana: Supervision, Project administration, Validation, Writing (review & editing), Visualization. Miqdarul Khoir Syarofit: Formal analysis, Validation, Writing (review & editing).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Funding Statement

The authors did not provide information regarding funding.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. Because the data include human participant information, they are not publicly available to protect participant privacy.

Ethical Declaration

This study involved human participants and was conducted in accordance with established ethical standards for social research and the principles of the Declaration of Helsinki. All participants provided informed consent before they participated in the study. They were informed of the research's purpose, the procedures involved, and their right to withdraw from the study at any time without consequences. The confidentiality and anonymity of all participants were strictly maintained throughout the research process.

Informed Consent Statement

The authors did not provide information regarding informed consent.

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Declaration of Generative AI and AI-Assisted Technologies

Portions of this manuscript were edited and enhanced using ChatGPT (OpenAI) to improve language clarity and structure. The tool was also used to refine the visual quality of research figures, including the research figures presented in this manuscript. The authors provided the original concepts, data, and figure designs, and carefully reviewed and edited all AI-assisted outputs to ensure their accuracy and relevance. All interpretations, analyses, and conclusions presented in this article are entirely the responsibility of the authors.

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