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PROJECT-BASED LEARNING AND THE DEVELOPMENT OF EFL PRE-SERVICE TEACHERS' DIGITAL COMPETENCE IN AN ISLAMIC UNIVERSITY

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ABSTRACT

Purpose – Teachers' digital competence plays an important role in technology-enhanced learning. This study explores how Project-Based Learning (PjBL) develops digital competence among EFL pre-service teachers of an Islamic university and examines their perceptions.

Methodology – This qualitative case study involved 80 EFL pre-service teachers at an Islamic state university in East Java Province, Indonesia. Data was collected through observations of three microteaching sessions, document analysis, and semi-structured interviews. The data were analyzed using Yin's (2011) five-phase analytic cycle, focusing on compiling, disassembling, reassembling, interpreting, and concluding.

Findings – PjBL fosters pre-service teachers' digital competence by enabling them to design, implement, and evaluate technology-enhanced learning in authentic teaching contexts. It also develops technical digital skills, pedagogical decision-making, reflective practice, collaboration, and higher-order thinking skills. The pre-service teachers perceived the PjBL approach as increasing their confidence, motivation, and professional identity as future teachers.

Novelty – While previous studies focused on general higher education contexts, this study contributes to the growing body of research on digital competence by applying the DigCompEdu framework to examine how Project-Based Learning supports pre-service teachers' competence development in Islamic higher education. It highlights how PjBL fosters the development of key DigCompEdu dimensions.

Significance – The findings provide practical insights for teacher education programs in designing technology-integrated learning and provide insights for improving technology integration strategies in culturally and faith-based higher education contexts.

Keywords: DigCompEdu, digital pedagogy, EFL teacher education, microteaching, project-based learning, pre-service teachers, technology integration, Islamic higher education.

INTRODUCTION

Digital transformation in education has increased both opportunities for learning and expectations of teachers' digital readiness (Guillén-Gámez et al., 2021; Lucas et al., 2021). Digital competence has increasingly been regarded as an important element of teacher education which prepares pre-service teachers for technology-enhanced learning environments (Maghfiroh et al., 2024). Teachers' continuous development is needed to ensure effective pedagogical integration of technology (Caena & Redecker, 2019).

The global coronavirus pandemic revealed vital gaps in teachers' skills to explore the use of technology in teaching and learning settings (König et al., 2020). This highlights the importance of teacher education programs in the pre-service teachers' development of their pedagogical skills through the integration of technology (Dias-Trindade et al., 2020). Despite being widely regarded as "digital natives," many pre-service teachers still lack the pedagogical digital competence required for effective technology-enhanced instruction (Márquez-Baldó et al., 2025). This discrepancy highlights the need for structured frameworks, guiding competence development during teacher preparation. In this regard, the DigCompEdu framework presents a comprehensive model that conceptualizes teachers' digital competence across pedagogical, professional, and ethical domains.

The DigCompEdu framework by Redecker (2017) conceptualizes six areas of teacher digital competence which includes the following: professional engagement, empowering learners, assessment, digital resources, teaching and learning, and facilitating learners' digital competence. These domains focus on technical skills, involving pre-service teachers' pedagogical and ethical application of digital technologies in real learning practice. The six DigCompEdu competence areas are aligned for pre-service teachers in addressing current educational demands. The framework provides a comprehensive foundation for examining how teacher education initiatives, such as project-based learning, can boost the progress of pre-service teachers' digital competence development.

Project-based learning (PjBL) has been significantly used as a learner-centered pedagogy that promotes authentic, collaborative, and technology-rich learning experiences (Rahmawati et al., 2020). PjBL connects theoretical knowledge with practical application by engaging pre-service teachers in designing,

implementing, and evaluating technology-enhanced instructional projects (Elmahdi et al., 2024). Research on PjBL in teacher education has consistently reported positive outcomes, including improvements in pre-service teachers' digital competence, pedagogical skills, professional identity, and other 21st-century competence (Belda-Medina, 2021; Puspitasari, 2020; Tristiana et al., 2024). However, it offers limited insights into how PjBL supports the development of specific dimensions of teacher digital competence as conceptualized by the DigCompEdu framework. Furthermore, little attention has been paid to faith-based higher education contexts, where competence development is shaped not only by professional requirements, but also by ethical and value-based educational orientations.

In this regard, an Islamic state university in East Java Province, Indonesia, represents a relevant context for investigation. The university integrates scientific knowledge and Islamic values in preparing future educators. Its approach is guided by the *Ulul Albab* philosophy, which emphasizes intellectual, moral, and spiritual development. This institutional orientation resonates with the demands of contemporary teacher education, where technology integration requires not only pedagogical effectiveness, but also ethical responsibility. Within this context, PjBL offers a pedagogical approach that engages pre-service teachers in authentic, technology-mediated learning experiences requiring collaboration, problem-solving, content creation, and reflection. Such experiences may support the development of digital competence while fostering the capacity to use digital technologies in ways that are pedagogically meaningful and aligned with broader ethical and educational values.

Therefore, this study is focused on the following concerns: (1) explore how PjBL develops EFL pre-service teachers' digital competence and (2) examine their perceptions of using PjBL to support digital competence development. By focusing on a faith-integrated teacher education setting, this study contributes to the growing literature on digital competence by highlighting how technological innovation can be fostered alongside ethical and religious values in teacher preparation programs. Accordingly, this study addresses the following research questions:

1. How does project-based learning develop the digital competence of EFL pre-service teachers?

2. What are the perceptions of EFL pre-service teachers on the use of project-based learning to develop their digital competence?

LITERATURE REVIEW

Digital Competence Framework for Pre-Service Teachers

Digital competence in teacher education is widely acknowledged as a multidimensional construct; however, the existing literature remains fragmented in explaining how such competence is actually developed through pedagogical practice (Aini et al., 2024). While the DigCompEdu framework by Redecker (2017) consists of six interconnected domains, namely digital resources, professional engagement, assessment, empowering learners, facilitating learners' digital competence, and teaching and learning, the framework remains largely descriptive and assessment-oriented, offering limited insight into how these dimensions are enacted through learning processes in teacher education (Garzón-Artacho et al., 2021).

Conversely, experiential approaches such as PjBL support pre-service teachers in engaging across these domains through authentic tasks, such as lesson design, resource development, collaboration, assessment activities, and learner-centered instruction. However, existing studies rarely explain how these competencies emerge through pedagogical cycles of design, implementation, and reflection (Durdu & Dag, 2017; Pooputta, 2023). This results in a conceptual gap between competence frameworks and practice-based development, particularly in EFL teacher education, where digital competence must simultaneously support instructional design, learner engagement, and communicative language learning (Chai et al., 2010). Therefore, further empirical investigation is needed to examine how PjBL mediates the development of all the six DigCompEdu domains. In light of this gap, the study has focused on how participation in PjBL contributes to the development of EFL pre-service teachers' digital competence.

The Incorporation of Digital Competence in the Current Educational Setting

Digital competence has become a critical requirement for teachers in contemporary educational settings, where technology is increasingly embedded in teaching, learning, communication, and assessment practices. Beyond functioning as content deliverers, teachers are expected to act as facilitators, designers, and innovators who can leverage digital technologies to support meaningful learning experiences (Revuelta-Domínguez et al., 2022). Consequently, teacher education programs face growing pressure to equip pre-service teachers with the competence necessary to integrate technology effectively into pedagogical practice.

Existing research consistently highlights the importance of strengthening digital competence among pre-service EFL teachers. Although many pre-service teachers are familiar with digital technologies, this familiarity does not necessarily translate into pedagogically meaningful technology integration (Dashtestani, 2014; Fitriah, 2018; Liza & Andriyanti, 2020). Across different contexts, pre-service teachers often demonstrate adequate operational skills, but still encounter difficulties in selecting, adapting, and utilizing digital tools to support language learning objectives. This suggests a persistent gap between technological proficiency and pedagogical application, indicating that digital competence involves more than the ability to use technology itself.

The challenge is particularly significant in EFL education, where digital technologies offer opportunities for authentic communication, multimodal learning, collaboration, and learner engagement. As students increasingly interact with digital media in both personal and educational contexts (Maher, 2020), future language teachers are expected to design learning experiences that respond to these changing practices. This expectation highlights the need for pedagogical approaches that provide authentic opportunities for pre-service teachers to develop digital competence across multiple dimensions, particularly through PjBL in teacher education contexts.

Project-based Learning as Instructional Design in ELT

Project-based learning (PjBL) is widely recognized as a learner-centered approach that promotes the development of twenty-first-century skills, including critical thinking, collaboration, communication, and problem-solving (Miller & Krajcik, 2019). By engaging learners in authentic and sustained inquiry, PjBL encourages them to construct knowledge, address real-world challenges, and produce meaningful outcomes

for specific audiences (Kokotsaki et al., 2016). These characteristics make PjBL particularly relevant to teacher education, where pre-service teachers are expected to bridge theoretical knowledge and classroom practice.

From a digital competence perspective, PjBL offers opportunities for pre-service teachers to engage in technology-mediated learning experiences that require planning, collaboration, content creation, reflection, and evaluation. Such activities correspond closely with several dimensions of the DigCompEdu framework by Redecker (2017), which prioritize teaching and learning, professional engagement, assessment, and digital resources. Rather than developing digital competence through isolated technology training, PjBL situates technology use within authentic pedagogical tasks, enabling pre-service teachers to experience how digital tools can support instructional decision-making and student learning.

Previous studies consistently report positive outcomes associated with PjBL implementation. Research has shown that PjBL can enhance learner engagement, collaborative knowledge construction, reflective thinking, and higher-order cognitive skills in both face-to-face and technology-mediated environments (Almulla, 2020; Eliyasni et al., 2019; Koh et al., 2010; Usher & Barak, 2018). Within teacher education, PjBL has also been linked to improvements in pedagogical knowledge, communication skills, self-confidence, and professional decision-making among pre-service teachers (Frank & Barzilai, 2004; Mettas & Constantinou, 2008). Collectively, these findings suggest that PjBL provides a conducive environment for developing knowledge, skills, and dispositions associated with digital competence.

However, while previous studies have established the educational benefits of PjBL, less attention has been given to understanding how digital competence is developed through project-based experiences in EFL teacher education, particularly within faith-integrated higher education contexts. This limitation highlights the need to examine how PjBL supports digital competence development among EFL pre-service teachers in contexts where technological innovation is expected to align with ethical and character development. Without such understanding, teacher education programs in Islamic higher education may lack empirical guidance for designing learning experiences that effectively integrate digital competence with their broader educational and moral objectives.

Islamic Higher Education and Teacher Preparation

Islamic higher education introduces a distinct orientation in teacher preparation by integrating professional competence with ethical, moral, and spiritual development. Unlike conventional frameworks that predominantly prioritize pedagogical effectiveness and instructional skills, this approach positions teacher education as a holistic process of intellectual and character formation (Succarie, 2024; Memon et al., 2024). However, this dual emphasis also creates a conceptual tension between competence-based training and value-based formation, particularly in relation to how both dimensions can be operationalized in practice.

This tension becomes increasingly relevant in the context of digital competence development. While dominant frameworks such as DigCompEdu emphasize pedagogical and technological capabilities, they provide limited explicit attention to ethical and value-driven dimensions of digital practice. In contrast, Islamic educational philosophy extends digital competence to include ethical responsibility in technology use (Falloon, 2020; Khatimah et al., 2025). Despite this conceptual alignment, empirical studies rarely

examine how such ethical–pedagogical integration is enacted in teacher education, particularly through instructional approaches such as PjBL. Given that PjBL requires collaboration, decision-making, and authentic technology use, it provides a relevant context for investigating how digital competence is shaped not only as a technical–pedagogical construct, but also as an ethically grounded practice. This gap highlights the need to examine how PjBL mediates the integration of technological, pedagogical, and ethical dimensions in Islamic higher education contexts. Such an investigation is particularly relevant in Islamic universities, where teacher preparation is expected to integrate digital competence with the intellectual, moral, and spiritual values underpinning institutional educational goals.

METHODOLOGY

Design

This study employed a qualitative, holistic case study design to comprehensively investigate individuals, events, and processes within a bounded system (Johnson & Christensen, 2004). This approach allows for an in-depth examination of how PjBL supports the development of pre-service teachers' digital competence through authentic classroom practices within an Islamic higher education context. This ensures that the study considers all relevant aspects of the case of lesson preparation, teaching activities, assessment, interactions, and the integration of Islamic values by providing a complete and coherent picture of the phenomenon under investigation. Furthermore, it is suitable for exploring pre-service teachers' perceptions within an Islamic university context.

Research Setting and Course Context

This study was conducted in the Microteaching course, a sixth-semester compulsory subject for EFL pre-service teachers at an Islamic state university in East Java Province, Indonesia. The course provides a structured simulation environment where students design, implement, and reflect on lessons while integrating pedagogical theory into practice. It also emphasizes the use of technology in lesson planning and teaching, making it an appropriate context to examine the implementation of PjBL and its role in developing digital competence.

Participants

The participants were 80 EFL pre-service teachers (34 male, 46 female) enrolled in three sixth-semester Microteaching courses of the English Language Education Program. Total population sampling was applied, involving all students engaged in the PjBL-based Microteaching. Inclusion criteria required enrollment in the course, full participation in all PjBL stages, and completion of prerequisite courses (TEFL, ICT for ELT, and Media in ELT), which provided foundational knowledge of pedagogy and technology integration. This full inclusion enabled a comprehensive analysis of students' experiences in developing digital competence through PjBL. The researcher gained ethics approval from faculty before collecting the data. Furthermore, the researcher provided informed consent, voluntary participation, and detailed information about the study. The participants have the full right to withdraw at any time without penalty. The researcher ensured anonymity and confidentiality through pseudonyms.

Data Sources and Instruments

The researcher gained data from semi-structured interviews, classroom observations, and document analysis. The observation and interview protocols were developed based on the DigCompEdu framework by Redecker (2017), which encompasses six areas of educators' digital competence, namely teaching and learning, digital resources, professional engagement, assessment, facilitating learners' digital competence, and empowering learners.

The observation protocol comprised 30 indicators across the six competence areas to examine how pre-service teachers demonstrated digital competence during Project-Based Learning (PjBL), particularly in using digital tools for communication, collaboration, resource creation, and project implementation. A total of 20 open-ended questions were given to participants to explore their experiences and perceptions of developing digital competence through PjBL in the interview stage, including technology use for collaboration, digital resource management, assessment, learner engagement, and digital skill development. To triangulate the findings, document analysis was conducted on students' project outputs, digital learning materials, presentation slides, lesson plans, and other digital artifacts produced during the PjBL process.

Data Collection Procedure

Classroom observations were conducted throughout the 16-week implementation of the PjBL project to examine how participants enacted their grammar lessons and integrated digital tools into their teaching practices. One observation session was carried out during each Microteaching performance. Lesson plans were collected at the end of the project and analyzed to identify the extent to which digital competence was incorporated into instructional design. In addition, the researcher conducted semi-structured interviews with 12 participants selected through criterion purposive sampling, which required that the participants had completed all stages of the PjBL project and participated in the microteaching sessions. Having experienced the entire PjBL process, these participants were able to provide rich insights into the learning experiences. The interview could be done within 30–45 minutes and was recorded for transcription. The implementation of the project observed the five stages of Project-Based Learning proposed by Stoller and Myers (2019), as follows: (1) preparation, (2) information gathering, (3) information processing, (4) information display, and (5) reflection.

The details of the instruments were guided by the DigCompEdu framework (Redecker, 2017). The observation protocol focused on identifying manifestations of digital competence, particularly participants' use of digital resources, technology-supported teaching practices, communication, collaboration, and digital content creation. As the course instructor, the researcher was directly involved in implementing the project and maintained sustained engagement with the participants throughout the study. While this role facilitated a deeper understanding of the learning context, several measures were taken to minimize potential bias. These included regular peer debriefing sessions with research supervisors and the maintenance of an audit trail documenting key decisions made during data collection and analysis.

Data Analysis

Data from observations, semi-structured interviews, and document analysis were analyzed using Yin's (2011) stages of compiling, disassembling, reassembling, interpreting, and concluding. This framework guided digital competence analysis development through PjBL. During the compiling phase, all data were organized into a structured database and repeatedly reviewed to enable the researcher to become familiar with the participants' experiences. During disassembling, the data were coded into meaningful units related to digital skills, collaboration, project challenges, and perceptions of PjBL. These codes were gathered into broader categories and themes during reassembling, enabling the identification of recurring patterns in digital competence development, independent learning, and classroom engagement. The flow of this analytic cycle is as illustrated in Table 3.

To enhance trustworthiness, emerging codes and themes were refined through peer debriefing with research supervisors and member checking with selected participants. During the interpreting phase, the emergent themes were examined in relation to the DigCompEdu framework by Redecker (2017). The framework served as a conceptual lens for understanding how participants developed and demonstrated digital competence throughout the PjBL process. Finally, the concluding phase synthesized the findings to address the research questions, while highlighting the contribution of PjBL, and suggesting areas for future research.

Following the thematic analysis, the identified themes were mapped onto the five stages of Project-Based Learning proposed by Stoller and Myers (2019), that is, from the stage of preparation, information gathering, information processing, information display, and reflection as the last stage. These stages served as an analytical framework for examining how digital competence emerged and developed throughout the project implementation. Rather than functioning as coding categories, the PjBL stages were used to organize and interpret the findings according to the chronological sequence of project activities. This approach enabled a process-oriented analysis of participants' engagement with digital technologies and provided insights into how different aspects of digital competence were fostered across each stage of the PjBL experience. Accordingly, the findings section is presented following these five stages to illustrate the progression of participants' digital competence development throughout the project cycle.

Table 1

The Process of Coding Based on the DigCompEdu Framework

Interview Excerpt	Initial Code	Category	Theme
"We discussed lesson plans and divided tasks through WhatsApp because it was easier"	Online communication and collaboration	Professional Engagement	Development of Digital Competence through PjBL
"I learned how to use Canva and Wordwall to create grammar activities for students."	Use of digital teaching resources	Digital Resources	Development of Digital Competence through PjBL

(continued)

Interview Excerpt	Initial Code	Category	Theme
"Using digital games helped me explain grammar concepts and keep students engaged."	Technology-supported instruction	Teaching and Learning	Development of Digital Competence through PjBL
"Quizizz helped me check whether students understood the grammar topic.	Digital assessment practices	Assessment	Development of Digital Competence through PjBL
"Students were more willing to participate when we used interactive activities and rewards during the lesson."	Student engagement	Empowering Learners	Development of Digital Competence through PjBL
"I became more confident in exploring new applications and using technology for teaching."	Digital competence development	Facilitating Learners' Digital Competence	Development of Digital Competence through PjBL

Trustworthiness

The data triangulation was applied by comparing the data from observations, interviews, and students' projects. To ensure scoring consistency, the students' projects were assessed by the researcher and an additional lecturer using the same scoring rubric. Differences in scoring were reviewed and discussed until a consensus was achieved. Peer debriefing sessions with research supervisors were also conducted to discuss emerging themes and minimize researcher bias. To ensure the credibility and reliability of the research findings, an audit trail was applied in the study. The audit trail also served as a means of checking the accuracy and consistency of the data by documenting all stages of the research process, allowing the researcher to identify and address any errors or inconsistencies.

RESULTS

How PjBL Develops the Digital Competences of EFL Pre-service Teachers

This section presents the findings of the study regarding the implementation of Project-Based Learning (PjBL) in EFL pre-service teacher education and its contribution to the development of digital competence. The findings are organized based on the five stages of PjBL by Stoller & Myers (2019), namely from the stage of preparation, information gathering, information processing, information display, and reflection. The analysis is based on classroom observations and field notes.

Preparation Stage: Introducing Project Goals and Raising Awareness of Digital Resources

The preparation stage functioned as an initial scaffold for developing pre-service teachers' digital competence, particularly within the Digital Resources dimension of the DigCompEdu framework. In this stage, the lecturer introduced project objectives, clarified expected outcomes, and organized students into

groups based on grammar topics (nouns, adjectives, verbs, and adverbs). Guidance was also provided on integrating digital technologies into instructional design, including presentation tools, interactive grammar platforms, and video-based learning media. Findings indicate that this initial orientation did not merely serve organizational purposes, but also fostered participants' awareness of the pedagogical functions of digital tools. Students began to shift from viewing technology as simple presentation support toward understanding its role in enabling specific learning activities aligned with instructional goals.

This shift is reflected in participants' responses. One student noted, *"I thought using technology in teaching was mainly about preparing slides, but now I realize different tools support different learning activities."* Another added, *"Not every digital tool fits every lesson, so we need to choose more carefully based on teaching goals."* These responses show that participants began to consider different functions of digital tools in relation to teaching activities and lesson objectives.

Information Gathering Stage: Enhancing Digital Content Creation through a Collaborative Project

The information-gathering stage involved group work in which pre-service teachers examined assigned topics while exploring various digital tools such as Canva, ZEP, Quizizz, Wordwall, and video-editing applications to support instructional design and content development. Document analysis showed that participants compared and evaluated different digital tools in relation to grammar teaching objectives. Rather than relying on familiar technologies, they considered the suitability of each tool for specific learning activities.

As a student stated, *"We tried different applications to find tools that could make grammar lessons more effective and engaging."* Participants reported that group discussions and lecturer feedback supported their selection and use of digital tools during the task. This stage fostered students' ability to identify, evaluate, and justify the use of digital resources for instructional purposes through group collaboration. "*We discussed our ideas before deciding which the best digital tool to use for our lesson".*

These findings indicate that information processing extended beyond content acquisition to evaluating pedagogical effectiveness and informing instructional decisions. Participants continuously collaborated and refined instructional materials and digital tools in response to challenges, learner needs, peer discussions, and lecturer feedback, enabling them to evaluate digital resources while strengthening collaborative and reflective technology integration.

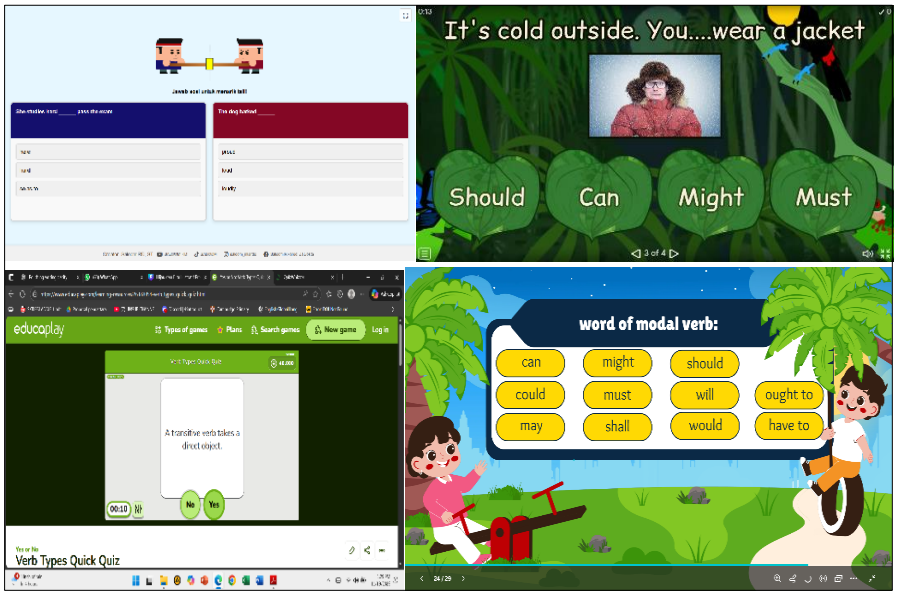
Information Processing Stage: Developing Digital Materials through Collaborative Project Work

The information processing stage involved groups synthesizing prior findings by organizing instructional content and sequencing grammar lessons into digital teaching materials, including slides, worksheets, quizzes, and instructional videos. Students engaged in iterative design, repeatedly revising materials to improve clarity and classroom suitability while experimenting with various platforms (e.g., ZEP, Gimkit, Mentimeter, Wordwall, Educaplay, Quizizz, Wayground, Quizwhizzer, and Google Apps Script). As one participant noted, "We revised activities several times because some platforms did not work as expected," while another stated, "We tried different applications to make students more active." In addition, as one participant explained, *"Everyone had their own task and were responsible for working together to choose*

the digital tools." These findings suggest that PjBL encouraged students' responsibility to develop, evaluate, and refine digital teaching materials while making informed decisions about the selection of digital tools to support their instructional objectives.

Figure 1

The Digital Platforms Used by Pre-service Teachers during Microteaching Practices



Information Display Stage: Applying Digital Technologies through Microteaching

The information display stage involved pre-service teachers delivering microteaching sessions using collaboratively developed digital instructional materials. Classroom observations showed that participants implemented various instructional strategies to engage learners during teaching, including real-time questioning, collaborative games, movement-based activities such as tug-of-war for grammar practice, as well as chants, rhymes, and contextual classroom routines to support interaction.

Observations also indicated the use of different digital tools during instruction. Canva and PowerPoint were used for presenting and structuring lesson content, while platforms such as ZEP, Wayground, Quizwhizzer, Wordwall, and Quizizz were used for quizzes, games, and student participation activities. Video-editing tools were used to present instructional videos that supported lesson explanation.

One participant stated, *"Using digital tools was not only about showing material but also making the class more active and engaging students."* Another added, *"We had to decide carefully when to use quizzes, games, or videos because each served a different teaching purpose."* Participants reported using different digital tools and instructional strategies during their microteaching sessions. Their decisions were based on considerations of lesson activities and classroom needs.

Reflection Stage: Critically Evaluating Technology Use for Continuous Professional Development

The reflection stage followed microteaching sessions in which pre-service teachers engaged in structured reflection activities supported by peer feedback, lecturer guidance, and rubric-based assessment. Participants reviewed their instructional performance, identified challenges in using digital tools, and discussed possible improvements for future teaching practice. Classroom observations showed that participants discussed the strengths and limitations of digital tools used during microteaching, particularly in relation to learner engagement and grammar instruction. Reflection sessions included comparisons of different instructional strategies and classroom experiences.

Interview data indicated that participants reviewed their use of digital tools after teaching sessions. One participant stated, *"From the reflection practice, I realized that some digital tools were not as effective as expected, so I need to adjust my teaching strategy."* Another noted, *"Feedback from peers and the lecturer helped me improve how I use digital applications in teaching."* The interview findings suggest that reflection guided the evaluation of instructional effectiveness and refinement of pedagogical decisions. Through self-reflection and feedback from peers and the lecturer, participants identified limitations, reconsidered the pedagogical value of technology, and refined their instructional strategies, fostering reflective and adaptive teaching practices.

Pre-service Teachers' Perception towards Digital Competence through PjBL

Interview data revealed that pre-service teachers perceived Project-Based Learning (PjBL) as a meaningful learning experience that contributed significantly to the development of their digital competence as future educators. Based on the DigCompEdu framework, participants' perceptions were categorized into six interrelated areas of digital competence, namely digital resources, empowering learners, facilitating learners' digital competence, assessment, teaching and learning, and professional engagement.

Professional Engagement

Participants perceived that collaborative project work strengthened their communication skills, teamwork, and professional interaction with peers throughout the learning process. Group discussions, task distribution, and peer feedback encouraged them to work collaboratively while learning how to solve problems collectively. One participant explained, *"Although there were differences of opinion, everything could be resolved through casual conversation. Our different personalities allowed each person to contribute unique perspectives that enriched the project."* Another participant shared, *"Harmony within the group had a very positive impact on performance, making the work finish faster and the results better."* These experiences indicate that participants perceived collaboration and communication as important aspects of their emerging professional development as future teachers.

Digital Resources

Participants reported that the project exposed them to various digital platforms that supported lesson preparation and material development. Applications such as Canva, Quizizz, Wordwall, and Educaplay helped them design teaching materials, while external sources such as AI tools and TikTok provided ideas

for creative teaching strategies. One participant stated, *"We used Canva and Wordwall to make lessons more engaging and easier to understand."* Another participant noted, *"We found teaching ideas on TikTok but always checked whether they were reliable and appropriate for our lessons."* These responses suggest that participants developed an awareness of how to identify, evaluate, and use digital resources appropriately for instructional purposes, demonstrating responsible and ethical technology use in designing learning materials.

Teaching and Learning

Participants perceived that repeated teaching practice significantly improved their confidence in delivering lessons and managing classroom interaction. They reported learning how to explain grammar concepts more clearly, organize classroom activities effectively, and create engaging learning environments. One participant explained, *"The teaching practice activities had a major impact on our learning, particularly in understanding how to teach, create a lively classroom atmosphere, and interact interactively with students."* Another participant shared, *"These teaching practices also taught us how to communicate more clearly in delivering material, accompanied by games and rewards that made students more enthusiastic and feel appreciated."* These findings indicate that participants perceived technology integration as closely connected to effective instructional delivery and classroom management.

Assessment

Participants recognized that digital platforms helped them create more interactive forms of classroom assessment and monitor student understanding more effectively during teaching practice. Interactive game-based learning activities allowed participants to evaluate learner responses. One participant commented, *"Using interactive quizzes made it easier to check students' understanding because we could see their responses immediately."* Another participant explained, *"Digital activities helped us check students' understanding without making them feel stressed."* These perceptions suggest that participants became more aware of how digital technologies can support formative assessment practices in classroom learning.

Empowering Learners

Participants perceived that technology-supported learning activities helped them create more student-centered learning environments where students became more active, motivated, and engaged during classroom interaction. The use of games, rewards, movement-based activities, and interactive media encouraged active participation while making grammar learning more enjoyable. One participant shared, *"Learning grammar became creative, not just memorization. We could design lessons using interactive digital media, making teaching sessions relevant and fun."* Another participant stated, *"Students became more enthusiastic when the activities involved games and direct interaction because they felt more involved during the lesson."* These responses indicate that participants recognized the role of digital technologies in supporting inclusive and engaging student-centered learning experiences.

Facilitating Learners' Digital Competence

Participants perceived that the project helped them recognize the importance of guiding students to engage actively with digital technologies during classroom learning. Through digital games, quizzes, and interactive platforms, they realized that technology can foster active participation while familiarizing students with digital learning environments. One participant explained, *"Using online games and quizzes helped students learn grammar while becoming more comfortable with technology."* Another reflected, *"I realized that students need opportunities to learn through digital platforms because technology is now an integral part of learning."* These findings suggest that participants recognized their future role in supporting learners' productive engagement with digital technologies. Overall, PjBL was perceived as fostering pre-service teachers' technical digital skills and comprehensive pedagogical understanding of meaningful technology integration across multiple dimensions of digital competence.

DISCUSSION

EFL Preservice Teacher Training and their Experience of Project-Based Learning in Developing Digital Competence

The findings of this study demonstrate that digital competence in PjBL extends beyond technical skills, functioning instead as pedagogical and reflective mechanisms that connect theoretical knowledge with instructional practice. Digital competence emerged as an enabling process through which pre-service teachers translated pedagogical concepts into concrete teaching actions, including lesson design, material development, collaboration, and assessment (Tomczyk, 2024; Waluyo, 2024). Rather than being externally acquired, digital competence was internally constructed through authentic, goal-oriented instructional tasks in which technology use was guided by pedagogical intent (Hirsch & Rubach, 2024; Rawat et al., 2024). Within the Islamic higher education context, this learning process was also shaped by responsibility, collaboration, and reflective practice. These values were evident in participants' shared decision-making, task distribution, and critical reflection throughout the PjBL activities, suggesting that digital competence developed through the interaction of PjBL and the institution's educational values.

Building on prior research (Durdu & Dag, 2017; Pooputta, 2023; Rahmawati et al., 2020), the study reconceptualizes digital competence development in PjBL as an iterative, socially mediated process rather than a linear acquisition of ICT skills. The findings demonstrate that implementation through cycles of design, implementation, and reflection enabled pre-service teachers to shift from operational tool use to pedagogically informed decision-making. In this process, PjBL functions as a pedagogical ecology that supports the transformation of technical abilities into situated teaching expertise through collaborative problem-solving and authentic instructional practice. Digital competence is, therefore, embedded in sustained instructional engagement rather than isolated ICT training.

Digital competence also develops through reflective and collaborative learning processes (Guo et al., 2020). In this study, collaboration was not only a strategy for completing project tasks, but also reflected the collaborative learning culture promoted within Islamic teacher education, where participants shared responsibilities, respected different perspectives, and supported one another throughout the project.

Reflection enabled pre-service teachers to refine instructional decisions, while collaboration supports the exchange of strategies and joint resolution of pedagogical and technical challenges. This shifts competence development from individual skill acquisition to socially constructed professional learning. Furthermore, motivation and confidence rise and blend through repeated practice in designing instructional materials and digital tools (Chan et al., 2021; Kos, 2024).

The findings further suggest that the development of digital competence was shaped by the interaction between PjBL and the Islamic higher education context. While PjBL provided opportunities for authentic and technology-rich learning, the institutional values of responsibility, collaboration, and reflective practice influenced how participants approached project work, selected digital tools, and evaluated their teaching practices (Nuryana et al., 2021). Furthermore, it supports value-oriented professional identity formation, integrating knowledge, pedagogy, and character development (Alimron et al., 2023). Consequently, digital tool use was guided not only by instructional effectiveness, but also by responsibility, meaningful engagement, and professional ethics, indicating that digital competence in Islamic teacher education integrates technological, pedagogical, and ethical dimensions.

Pre-service Teachers' Perception towards Digital Competence through PjBL

The findings indicate that PjBL was perceived by pre-service teachers as an integrative learning approach that develops digital competence alongside pedagogical practice. Rather than functioning as isolated technical skills, digital competence emerges as embedded practices within instructional decision-making processes. Participants reported that through authentic teaching experiences, they gradually developed the ability to select, adapt, and integrate digital tools for lesson design, material development, classroom interaction, and assessment. This indicates that digital competence is constructed through situated practice rather than acquired through technical instruction alone, supporting the view that competence develops through authentic, goal-oriented learning environments (Tseng & Yeh, 2019; Chai et al., 2010).

From a theoretical perspective, this process reflects the integration of multiple competence domains as conceptualized in the DigCompEdu framework, particularly teaching and learning, digital resources, empowering learners, assessment, professional engagement, and facilitating digital competence. Collaborative project work strengthened professional engagement through teamwork and peer feedback, while lesson design, digital material development, and classroom implementation supported the remaining competence areas through authentic teaching practice. However, the present study's findings extend this framework by showing that competence development was not merely domain-based, but process-driven, emerging through iterative cycles, focusing on instructional design, application, and reflection. In this process, pre-service teachers shifted from the operational use of digital tools toward pedagogically informed decision-making, where technology selection was guided by instructional intent rather than technical familiarity alone. This supports prior findings that digital competence is better understood as a developmental and practice-embedded construct rather than a static skill set (Durdu & Dag, 2017; Pooputta, 2023). This study further suggests that digital competence develops through authentic PjBL experiences shaped by the value-based learning environment of Islamic higher education, rather than through the acquisition of just technical ICT skills.

Collaboration and reflection further strengthen this developmental process. Participants emphasized that peer interaction enabled them to negotiate roles, exchange instructional strategies, and jointly solve pedagogical and technical challenges. Feedback from peers and instructors also helped refine lesson design and improve the integration of digital tools in subsequent teaching practices (Chan et al., 2021; Guo et al., 2020). However, despite enhanced competence development, differences in digital expertise occasionally created unequal participation within project groups, reflecting the uneven distribution of technological confidence in collaborative learning environments (Ohle-Peters et al., 2024).

In addition, PjBL contributes to motivational and identity development. Participants reported increased engagement, creativity, and confidence when designing technology-enhanced lessons. Digital tools did not solely drive this motivation, but by meaningful participation in authentic instructional tasks that allowed them to see the impact of their pedagogical decisions. Prior studies similarly indicate that PjBL supports the development of positive professional identity and attitudes toward digital teaching by expanding pedagogical possibilities and enhancing instructional agency (Tsybulsky & Muchnik-Rozanov, 2023).

However, the findings in the present study also reveal structural and contextual challenges, including limited time, differences in technical ability, and unequal access to digital resources. These constraints suggest that while PjBL is effective in fostering digital competence, its success depends on structured guidance and institutional support. This is aligned with the view of Dolezal et al. (2025), who emphasize that digital competence should be systematically integrated across teacher education curricula rather than treated as an additional or peripheral skill. Without such integration, competence development risks becoming inconsistent and uneven across learners.

In the Islamic higher education context, these findings also highlight the role of a value-based teacher development program. Collaborative learning, reflective practice, and responsible engagement with technology reflect Islamic educational values such as *amanah* (responsibility), *ta'awun* (cooperation), and *adab* (ethical conduct in learning). These values are not treated as separate content but are enacted through learning processes that emphasize discipline, accountability, and purposeful engagement. Through project activities that required participants to collaborate with peers, make instructional decisions, manage digital resources responsibly, and reflect on their teaching practices, PjBL provided opportunities for students to internalize professional and ethical responsibilities alongside technological and pedagogical skills. This indicates that PjBL emphasizes supporting the development of technical and pedagogical competence and contributes to ethical and professional identity formation consistent with the mission of Islamic education (Alimron et al., 2023; Nuryana et al., 2021).

Although conducted in an Islamic university context in Indonesia, the combination of collaborative of PjBL, guided reflection, intentional use of digital tools, and a values-focused approach to teaching reflects broad instructional design ideas that can be related to many different EFL teacher education programs. The model builds on authentic teaching tasks, continuous feedback, and digital competencies, which are core aspects of teacher readiness. It may be adapted by faith-based and culturally diverse higher education institutions while remaining responsive to their educational values and curriculum goals.

CONCLUSION

Project-Based Learning (PjBL) provides an effective pedagogical approach for fostering EFL pre-service teachers' digital competence through authentic learning experiences. Participants developed competence not merely by using digital tools, but by integrating technology into instructional design, collaborative learning, reflective practice, and informed pedagogical decision-making. In the Islamic higher education context, this process was further shaped by values of responsibility, collaboration, reflection, and ethical technology use, highlighting the importance of contextual and value-oriented learning environments. These findings demonstrate that digital competence extends beyond technical skills to encompass pedagogical judgment and professional values, offering insights that may inform teacher education programs in diverse EFL and higher education contexts. The findings imply that EFL teacher education programs beyond the Islamic university context may strengthen pre-service teachers' digital competence by adopting pedagogical approaches that integrate PjBL with collaborative, reflective, value-based learning, and purposeful technology use. This approach may also be adapted by other faith-based and culturally diverse higher education institutions. Nevertheless, as this study was conducted in a single Islamic university, future research should examine the generalization of these findings across diverse teacher education contexts and their long-term impact.

CONFLICT OF INTEREST STATEMENT

The authors have no potential conflict of interest.

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