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Original Research Article

Designing Learning Projects to Develop AI Use Competence for Primary Education Majors

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Abstract: In the context of educational digital transformation and the rapid development of artificial intelligence (AI), equipping pre-service teachers with the competence to use AI has become an urgent requirement. This article proposes a course redesign model based on project-based learning (PBL) to foster AI use competence among students majoring in Primary Education. Grounded in the national digital competence framework, the professional characteristics of primary school teachers, and the theoretical foundations of PBL, the study reconstructed the course outline of "Methods of Teaching Morality in Primary Education" into ten learning projects. Each project was associated with a concrete product and integrated AI tools for specific learning purposes, including conceptual understanding, information search and verification, practice, and product creation. The model was implemented with 83 third-year students in a teacher education program. Data were collected through project portfolios, pedagogical products, AI-use records, observation, and rubric-based assessment. The findings indicate that the model not only helped students develop responsible AI use but also strengthened pedagogical competence, critical thinking, and instructional design capacity. Statistically significant improvements were found across all evaluated criteria between the pre- and post-intervention stages. The study contributes a practical pathway for innovating teacher education in the digital era.

Keywords: Artificial Intelligence, Project-Based Learning, Primary Education, Digital Competence, Course Design, Teacher Education.

1. INTRODUCTION

The rapid development of digital technologies, especially artificial intelligence (AI), is reshaping contemporary education. AI is no longer merely a support tool; it is gradually becoming a constitutive element of a new learning environment in which learners are expected to interact with, exploit, and critically evaluate information in an active and responsible manner. In this context, pre-service teachers are expected not only to use technology, but also to master AI in order to support teaching, learning material design, and the resolution of authentic educational situations.

In Vietnam's educational digital transformation agenda, digital competence has been identified as one of the core learner competences. Circular No. 02/2025/TT-BGDĐT further recognizes AI as an independent competence domain within the national digital competence framework, emphasizing the need for learners to use AI ethically, critically, and creatively. This policy context creates an urgent need for teacher education institutions to redesign curricula, pedagogies, and learning environments. However, current AI use among university students is often spontaneous, weakly guided, and susceptible to over-reliance on automated tools. Students may use AI to obtain quick answers without adequate attention to source verification, analysis, and contextual application. Such practices not only reduce learning quality but also increase the risk of academic integrity violations.

Against this backdrop, project-based learning (PBL) offers a suitable instructional approach. PBL creates an environment in which students engage in authentic tasks and mobilize knowledge, skills, and tools to solve problems. When AI is meaningfully integrated, it can function as a learning support mechanism that enhances inquiry, design, feedback, and product development. Therefore, this study aims to redesign a course into a project-based format in order to develop AI use competence among Primary Education majors through a concrete system of learning projects.

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2. LITERATURE REVIEW

2.1. AI use Competence for Primary Education Majors

Artificial intelligence has become one of the most transformative technological forces in contemporary education. AI is commonly defined as the capacity of computer systems to perform cognitive functions traditionally associated with human intelligence, such as learning, reasoning, adaptation, problem solving, and decision making. Previous scholarship has also highlighted AI as a family of technologies capable of recognizing, understanding, and acting autonomously while continuously learning from data. Within educational settings, these capacities create both opportunities and challenges for teaching and teacher education. From the perspective of teacher professionalism, the role of teachers is shifting from technology users to designers of learning ecosystems mediated by AI. The UNESCO AI Competency Framework for Teachers emphasizes that AI competence includes an integrated combination of knowledge, skills, attitudes, and values that enable educators to use AI responsibly and effectively. These dimensions include conceptual knowledge of AI, the ability to design and evaluate AI-supported learning activities, and ethical awareness regarding privacy, fairness, transparency, and accountability.

Recent studies have framed AI competence as a multidimensional construct involving AI literacy, readiness, and professional competence. Other scholars have extended the TPACK model toward AI-TPACK, arguing that teachers must synthesize pedagogical knowledge, content knowledge, and AI-related technological knowledge to design transformative learning experiences. In primary education, this competence is especially important because teachers shape the foundational cognitive, moral, and social development of young learners.

In Vietnam, Circular No. 02/2025/TT-BGDĐT formally establishes 'AI application' as Domain 6 within the national digital competence framework for learners. This domain includes the ability to identify, use, and critically evaluate AI applications for teaching, learning, and research. It also encourages creative use of AI for digital product development, data analysis, and problem solving while maintaining ethical and socially responsible practices. These policy directions underscore the need for systematic AI education in teacher preparation programs rather than fragmented exposure to digital tools.

2.2. Project-Based Learning as a Pedagogical Framework

Project-based learning has been widely recognized as an effective learner-centered approach for developing complex competences. In PBL, knowledge is constructed through sustained inquiry into authentic problems, collaborative activity, product creation, and reflective evaluation. Instead of receiving knowledge passively, learners participate actively in defining problems, gathering information, testing ideas, and presenting outcomes. The core features of PBL include authenticity, inquiry orientation, collaboration, reflection, and product orientation. These features make PBL particularly suitable for the development of twenty-first century competences such as critical thinking, creativity, communication, and self-regulated learning. Within teacher education, PBL has also been shown to support reflective practice, autonomy, and the capacity to transfer theoretical knowledge into professional action.

When supported by AI, PBL can be strengthened through enhanced access to information, idea generation, formative feedback, and digital product design. In this sense, PBL provides the experiential structure, while AI supplies flexible tools that can deepen cognitive engagement and support differentiated learning.

2.3. The Role of AI across Project Stages

In the proposed model, AI is not used to replace student thinking; rather, it functions as a learning assistant across different project stages. *First*, AI supports conceptual understanding at the beginning of the project by explaining concepts, summarizing texts, and providing examples. *Second*, AI can generate ideas during planning and design, helping students broaden perspectives and overcome initial barriers in creative thinking. *Third*, AI supports checking and critique during project implementation. Students can use AI to review logic, detect inconsistencies, compare alternatives, and refine arguments. In this role, AI contributes to the development of critical thinking by acting as a feedback partner rather than a final authority. Finally, AI can support product creation, such as drafting texts, generating instructional materials, designing visuals, or preparing assessment tools. However, students are expected to document their prompts, revisions, and decisions in order to ensure academic transparency and accountability.

3. METHOD

This study adopted an instructional design approach that combined theoretical analysis with pedagogical implementation in a teacher education context. The participants were 83 third-year students majoring in Primary Education who enrolled in the course 'Methods of Teaching Morality in Primary Education.'

The original course outline was restructured into a project-based format consisting of ten learning projects. Each project was associated with a specific pedagogical product and required students to use AI tools for clearly defined purposes, such as concept clarification, idea generation, source checking, feedback, and product development.

Three main methods were employed. First, document analysis was used to establish the theoretical foundation related to AI competence and project-based learning. Second, instructional design and course modeling were applied to develop a project implementation process aligned with the intended learning outcomes. Third, pedagogical observation and product analysis were used to evaluate the extent to which students developed AI use competence and pedagogical skills.

Data sources included student portfolios, project products, and records documenting AI use. Evaluation was conducted through a four-level rubric covering AI use, information verification, pedagogical design, product quality, and AI documentation. Descriptive analysis and paired-samples t-tests were used to examine changes before and after the intervention.

4. RESULTS

4.1. Course Redesign into Ten Learning Projects

The course was redesigned into ten projects organized into three clusters: (1) foundational understanding, (2) instructional design, and (3) implementation and assessment. Table 1 summarizes the ten projects, their central problems, the intended use of AI, and the expected products.

Table 1

Project	Cluster	Driving question / focus	AI-supported tasks	Expected product
1	Foundations	What are the key moral categories and functions of morality?	Extract key ideas; organize a concept map; generate captions; check inconsistencies	Concept map, A3 infographic, 800–1,000-word explanation
2	Foundations	How can moral norms be transformed into age-appropriate teaching situations?	Generate diverse scenarios; propose guiding questions; detect bias	Case bank of 12–15 situations with pedagogical guidance
3	Foundations	How can behavioral psychology support moral habit formation?	Summarize theory; propose a 2-week intervention; build observation plans	Micro-intervention plan and observation form
4	Design	How can lesson objectives be measurable and teachable?	Rewrite objectives using action verbs; test measurability	Objective set and alignment table
5	Design	Why can morality not be taught through explanation alone?	Build comparison tables; identify logical gaps	Analytical paper and design logic diagram
6	Design	How can tasks address knowledge, attitude, and behavior?	Generate task ideas; check age appropriateness; remove duplication	Package of at least 12 tasks with assessment guidance
7	Design	How should methods be combined for understanding and moral practice?	Draft stories/dialogues; create Socratic questions; design games	Two-period teaching script and learning materials
8	Implementation	Which teaching media best support moral learning without imposing values?	Create storyboard; design posters/worksheets; suggest selection criteria	Print and digital material package with usage guide
9	Implementation	What experiential activities allow pupils to practice morality naturally?	Develop timeline; assign roles; draft parent messages; produce safety checklist	Field-trip or extracurricular activity proposal
10	Assessment	How can moral learning be assessed fairly and developmentally?	Generate rubric levels; design questions by competence; check alignment	Rubric, 20-item question bank, and feedback guide

4.2. Pilot Implementation and Assessment Design

The pilot implementation involved 83 third-year Primary Education majors divided into ten groups of eight to nine students. Each group completed the full sequence of ten learning projects and built a comprehensive portfolio, including teaching materials, lesson plans, assessment tools, and AI-use documentation.

Evaluation focused on two broad aspects: the extent and quality of AI use during project implementation, and the pedagogical quality of the final products. A four-level rubric was used throughout the course to assess both process and outcome dimensions.

Table 2: Rubric for evaluating AI use and project products

Criterion	Level 1 (Not achieved)	Level 2 (Minimally achieved)	Level 3 (Achieved)	Level 4 (Strong)
AI use	Fragmented use; copying	Used but not well aligned	Appropriate and selective use	Flexible, creative use with justification
Information verification	No checking	Preliminary checking	Comparison with sources	Multi-source verification and critique
Pedagogical design	Weak logic	Basic structure	Aligned with teaching goals	Creative and contextually appropriate design
Product quality	Incomplete	Meets minimum requirements	Clear and sufficiently complete	Polished and highly presentable
AI documentation	Absent	Present but superficial	Reasonably complete	Clear documentation with reflection

4.3. Descriptive Findings

Across the ten groups, the assessment results indicate that most groups performed at Level 3 or above on both AI use and project product quality. Table 3 presents the distribution of AI use levels, while Table 4 summarizes the quality of project products.

Table 3: Distribution of AI use levels

Level	Number of groups	Percentage
Level 1	0	0%
Level 2	2	20%
Level 3	5	50%
Level 4	3	30%

Table 4: Distribution of project product quality levels

Level	Number of groups	Percentage
Level 1	0	0%
Level 2	1	10%
Level 3	6	60%
Level 4	3	30%

Specifically, 80% of the groups reached Level 3 or Level 4 in AI use, and 30% achieved the highest level, demonstrating flexible and explainable use of AI. Regarding product quality, 90% of the groups reached Level 3 or Level 4, suggesting that the integration of AI contributed positively to pedagogical design quality and the overall completeness of project outputs. Groups at Level 4 generally showed stronger evidence of combining AI support with pedagogical reasoning and transparent documentation of AI-assisted work.

4.4. Paired-Samples T-Test Results

To examine changes in students' AI use competence before and after the intervention, paired-samples t-tests were conducted. The criteria were measured on a four-point scale aligned with the rubric.

Table 5: Descriptive statistics before and after the intervention

Criterion	Time	Mean	SD	N
AI use	Pre	2.31	0.52	83
	Post	3.28	0.48	83
Information verification	Pre	2.15	0.49	83
	Post	3.10	0.51	83
Pedagogical design	Pre	2.40	0.55	83
	Post	3.35	0.46	83
Product quality	Pre	2.45	0.50	83
	Post	3.42	0.44	83
AI documentation	Pre	2.05	0.47	83
	Post	3.18	0.49	83

Table 6: Paired-samples t-test results

Criterion	Mean difference	SD	t	df	Sig. (2-tailed)
AI use	0.97	0.41	17.85	82	.000
Information verification	0.95	0.39	18.62	82	.000
Pedagogical design	0.95	0.44	16.98	82	.000
Product quality	0.97	0.42	17.56	82	.000
AI documentation	1.13	0.45	18.94	82	.000

The paired-samples t-test results show statistically significant differences between pre-intervention and post-intervention scores for all criteria ($p < .001$). The greatest improvement was found in AI documentation (mean difference = 1.13), indicating that students became substantially more capable of recording, reflecting on, and explaining their AI use. Strong improvements were also observed in pedagogical design and product quality, suggesting that AI integration supported not only technical performance but also professional learning.

DISCUSSION

The findings suggest that project-based course redesign provides an effective pedagogical structure for developing responsible AI use among pre-service primary teachers. Rather than treating AI as an isolated technological skill, the model embedded AI within authentic professional tasks such as lesson design, case construction, instructional media development, and assessment planning. This integration appears to have supported a more meaningful and transferable form of competence development.

An important contribution of the model is that AI use was consistently tied to documentation and explanation. Students were expected to record prompts, revisions, and decisions rather than simply presenting final products. This requirement likely reduced uncritical dependence on AI and fostered a more reflective orientation toward automated support.

The results also indicate that AI-enhanced PBL can strengthen pedagogical competence. Students did not only improve in using AI tools; they also produced more coherent instructional designs, higher-quality pedagogical products, and stronger evidence of alignment between goals, activities, and assessment. This supports the view that AI is most educationally valuable when integrated into structured pedagogical processes rather than used for answer retrieval alone.

At the same time, a minority of groups remained at the intermediate level, especially in information verification and critical use of AI feedback. This highlights the need for continued guidance in source checking, error detection, and ethical decision making. Future implementations may therefore benefit from more explicit training on prompt design, evidence verification, and academic integrity.

5. CONCLUSION AND IMPLICATIONS

This study proposed and implemented a project-based course redesign model to develop AI use competence among Primary Education majors. The findings demonstrate that integrating AI into learning projects can improve not only students' technological competence, but also their pedagogical capacity, critical thinking, and awareness of academic ethics.

The ten-project system created a learning environment closely connected to future professional practice, in which AI competence was developed through concrete outputs such as lesson plans, digital learning materials, assessment tools, and AI documentation records. These findings reinforce the argument that AI becomes educationally meaningful when it is embedded in well-structured learning tasks and accompanied by transparent evaluation mechanisms.

Based on the results, several implications can be proposed. First, AI competence should be integrated more explicitly into teacher education program outcomes. Second, institutions should develop clear criteria and regulations for AI use in learning to ensure transparency and academic integrity. Third, project-based learning should be expanded in ways that connect course content with professional contexts. Fourth, teacher educators themselves need continuous professional development in digital competence and AI-supported pedagogy.

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