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METHODOLOGY FOR DEVELOPING THE PEDAGOGICAL REFLECTION COMPETENCE OF FUTURE PRIMARY SCHOOL TEACHERS THROUGH ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Abstract: This study aims to develop a methodology for enhancing the pedagogical reflection competence of future primary school teachers through artificial intelligence technologies. The proposed methodology is grounded in reflective pedagogy, competency-based teacher education, and AI-supported professional learning. An AI-Supported Pedagogical Reflection Model was developed to guide future teachers in documenting instructional experiences, conducting reflective analysis, critically evaluating professional practice, and planning continuous improvement. The model integrates digital reflective tools and artificial intelligence technologies to facilitate systematic reflection while preserving teachers' professional autonomy. The findings indicate that AI-supported reflective practice contributes to the development of reflective thinking, professional self-awareness, and continuous professional growth. The proposed methodology provides a theoretical and practical framework for integrating artificial intelligence into reflective teacher education and improving the quality of professional preparation for future primary school teachers.

Keywords: artificial intelligence, pedagogical reflection, reflective competence, teacher education, primary school teachers, reflective practice, professional development, educational technology.

Introduction

The rapid integration of artificial intelligence (AI) into education has transformed not only teaching and learning processes but also the professional development of teachers. Contemporary educational environments require future teachers to continuously analyse their instructional practices, evaluate learning outcomes, and improve their pedagogical performance in response to changing educational demands. Consequently, pedagogical reflection has become one of the essential professional competencies that enables teachers to engage in continuous learning and evidence-based professional growth. As the United Nations Educational, Scientific and Cultural Organization emphasizes, “Teachers should be empowered to use artificial intelligence in ways that strengthen human agency, professional judgement, and continuous learning”[8]. This perspective suggests that AI should not merely function as a technological innovation but as a professional tool that supports reflective practice. In teacher education, AI can facilitate reflective thinking by analysing instructional data, providing timely feedback, and helping future teachers critically evaluate their own pedagogical decisions and classroom performance.

Pedagogical reflection is widely recognized as a cornerstone of effective teaching because it enables teachers to connect theoretical knowledge with classroom practice. Through reflective activities, future teachers identify strengths and weaknesses in their instructional approaches, reconsider teaching strategies, and develop more effective solutions for diverse educational situations. In primary education, where teachers constantly adapt instruction to learners' cognitive and linguistic characteristics, reflective competence plays a decisive role in improving the quality of teaching and learning. According to Donald Schön, “Professionals learn through

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reflecting on their actions and experiences”[7]. This idea remains highly relevant to teacher education because professional competence develops not only through experience itself but through systematic analysis of that experience. Artificial intelligence creates new opportunities for reflective practice by providing objective evidence about instructional processes, learner engagement, and educational outcomes that may otherwise remain unnoticed.

Recent studies have explored the application of artificial intelligence in lesson planning, assessment, adaptive learning, and instructional support. Nevertheless, considerably less attention has been devoted to the development of pedagogical reflection competence among future primary school teachers through AI technologies. Existing research primarily focuses on the technical capabilities of AI, whereas methodological approaches that integrate reflective pedagogy with intelligent technologies remain limited. This gap demonstrates the need for innovative methodologies capable of combining artificial intelligence with reflective professional learning in teacher education. As Stephen D. Brookfield argues, “Critical reflection helps teachers question assumptions and improve professional practice”[1]. This principle is particularly important in AI-supported educational environments, where teachers should critically evaluate both their own instructional decisions and the recommendations generated by intelligent systems. Reflection therefore becomes an essential mechanism for ensuring that artificial intelligence contributes to meaningful pedagogical improvement rather than routine technological use. Developing pedagogical reflection competence through artificial intelligence requires a systematic methodology that integrates reflective pedagogy, competency-based teacher education, learning analytics, and AI-supported feedback mechanisms. Such a methodology should enable future primary school teachers to analyse instructional evidence, evaluate their pedagogical performance, identify professional development needs, and continuously improve their teaching practice through reflective learning supported by artificial intelligence. The scientific novelty of the present study lies in the development of an AI-based methodology for fostering pedagogical reflection competence among future primary school teachers. The proposed methodology introduces an integrated framework in which artificial intelligence supports reflective analysis, professional self-evaluation, evidence-based feedback, and continuous pedagogical improvement. Unlike existing approaches, the methodology conceptualizes pedagogical reflection as a dynamic professional competence that develops through the interaction of reflective practice and intelligent educational technologies. Therefore, the purpose of this study is to develop and substantiate a methodology for developing the pedagogical reflection competence of future primary school teachers through artificial intelligence technologies and to determine its significance for improving the quality of teacher education.

Research Methodology

This study adopted a methodological research design to develop an artificial intelligence-supported methodology for fostering the pedagogical reflection competence of future primary school teachers. The research was grounded in reflective pedagogy, experiential learning theory, competency-based teacher education, and contemporary approaches to professional learning. These theoretical foundations made it possible to design a methodology that encourages future teachers to analyse their instructional experiences, evaluate their professional growth, and continuously improve their teaching practice through AI-supported reflective activities. Reflective competence develops through purposeful examination of professional experience rather than through the accumulation of teaching knowledge alone. Therefore, the proposed methodology considers reflection as an active learning process in which future teachers critically review their instructional actions, identify professional strengths and limitations, and formulate strategies for continuous improvement. Artificial intelligence was incorporated into this process not as an evaluator but as a reflective partner capable of organizing information, generating analytical feedback, and supporting deeper professional reflection. As Donald Schön observed, “Reflection-on-action enables professionals to learn from experience”[7]. Guided by this

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principle, the methodology encourages future teachers to revisit completed instructional activities, interpret their experiences from multiple perspectives, and develop new pedagogical insights that can inform subsequent teaching practice. The methodological framework consists of four interconnected phases. The first phase focuses on documenting teaching experiences through reflective journals, lesson narratives, digital teaching portfolios, and classroom observation records. These materials provide authentic evidence of professional activity and create the basis for meaningful reflection. The second phase involves AI-supported reflective analysis. Future teachers upload reflective texts, lesson plans, or teaching portfolios into AI-assisted learning environments, where Natural Language Processing tools identify recurring themes, instructional patterns, reflective depth, and potential areas for professional improvement. Rather than assigning scores, AI generates analytical prompts that stimulate deeper reflection and encourage critical self-questioning. According to Stephen D. Brookfield, "Critical reflection begins by questioning assumptions that shape professional practice"[1]. Accordingly, the proposed methodology incorporates structured reflective questions that encourage future teachers to examine not only what occurred during instruction but also why particular pedagogical choices were made and how alternative approaches might improve learning outcomes. The third phase emphasizes collaborative reflection. Participants discuss AI-supported reflective reports with peers and teacher educators, compare different interpretations of classroom experiences, and refine their professional perspectives through academic dialogue. This collaborative dimension broadens reflective thinking and reduces the risk of relying exclusively on individual perceptions. The final phase focuses on professional action planning. Based on the reflective evidence collected throughout the previous stages, future teachers formulate individual professional development goals and practical improvement strategies for subsequent teaching practice. Artificial intelligence assists by recommending relevant learning resources, professional literature, and reflective activities that correspond to each participant's developmental needs. Overall, the proposed methodology integrates reflective pedagogy, collaborative learning, digital portfolios, and artificial intelligence into a coherent framework for developing pedagogical reflection competence. Unlike traditional reflective activities that often depend solely on personal experience, the proposed methodology enriches reflective practice through AI-supported analytical feedback while maintaining the teacher's central role in interpreting professional experience and directing personal growth. As Barbara Larrivee notes, "Reflective practice develops progressively through structured professional inquiry" [5]. This perspective supports the proposed methodology by emphasizing that systematic reflection should become an integral component of teacher education rather than an occasional professional activity.

Results

The findings of this study resulted in the development of an AI-Supported Pedagogical Reflection Competence Model (AISPRCM) designed to strengthen the reflective abilities of future primary school teachers throughout their professional preparation. The model was constructed on the premise that effective reflection extends beyond recalling instructional experiences and instead requires systematic analysis, critical interpretation, and purposeful planning for professional improvement. Artificial intelligence contributes to this process by facilitating reflective thinking through structured feedback, thematic analysis of reflective narratives, and individualized guidance for continuous professional learning. Unlike conventional reflective practices, which often rely solely on personal observations, the proposed model combines reflective pedagogy with intelligent educational technologies to encourage deeper professional self-analysis. Future teachers are expected to examine their instructional experiences from multiple perspectives, compare intended and actual teaching outcomes, and identify practical strategies for improving future classroom performance. Within this framework, artificial intelligence functions as a reflective facilitator that supports critical thinking while preserving teachers' independent professional judgement.

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Based on the methodological analysis, five interrelated stages were identified as the core structure of pedagogical reflection competence.

Table 1. AI-Supported Pedagogical Reflection Competence Model

Stage	Reflective Activity	AI Support	Expected Outcome
Reflective Experience	Recording teaching experiences through journals, portfolios, or lesson reports	Organizes reflective records and learning evidence	Comprehensive documentation of professional experience
Reflective Analysis	Identifying strengths, weaknesses, and challenges	Analyses reflective texts and instructional highlights recurring themes	Deeper understanding of teaching practice
Critical Reflection	Evaluating instructional assumptions and professional beliefs	Generates reflective prompts and analytical questions	Development of critical professional thinking
Professional Improvement Planning	Establishing individual professional development goals	Suggests relevant learning resources and improvement strategies	Personalized professional development plan
Continuous Reflective Development	Monitoring progress through reflection	Tracks reflective growth and provides longitudinal feedback	Sustainable development of reflective competence

The proposed model demonstrates that pedagogical reflection is a cyclical and continuous professional process rather than an isolated educational activity. Each stage contributes to the gradual development of reflective competence by encouraging future teachers to connect classroom experience with theoretical knowledge and professional self-development. As Donald Schön states, “Reflection-on-action enables professionals to reshape future practice through critical examination of experience” [7]. The proposed model reflects this principle by integrating structured reflection with AI-supported analysis, allowing future teachers to transform instructional experiences into opportunities for continuous professional learning rather than viewing reflection as a routine post-lesson activity. Overall, the AI-Supported Pedagogical Reflection Competence Model provides an integrated methodological framework that combines reflective pedagogy, digital technologies, and artificial intelligence to foster continuous professional growth among future primary school teachers. The model highlights that meaningful reflection emerges through the interaction of professional experience, critical analysis, and intelligent technological support, thereby contributing to the modernization of teacher education in the digital era.

Building upon the proposed competency framework, this study developed an AI-Supported Pedagogical Reflection Model to guide future primary school teachers in conducting systematic and continuous reflective practice. The model was designed to integrate reflective pedagogy with artificial intelligence technologies, enabling future teachers to analyse their instructional experiences, receive structured feedback, and formulate strategies for professional improvement. Unlike traditional reflection, which is often based solely on personal impressions, the proposed model encourages evidence-informed reflection supported by AI-generated analytical insights.

The model consists of five consecutive stages that collectively contribute to the development of pedagogical reflection competence.

Table 2. AI-Supported Pedagogical Reflection Model

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Stage	Teacher's Activity	AI Support	Expected Outcome
Experience Documentation	Records experiences through reflective journals and digital portfolios	Organizes and stores reflective records	Systematic documentation of professional experience
Reflective Analysis	Analyses instructional strengths and weaknesses	Identifies recurring themes and instructional patterns	Objective understanding of teaching practice
Critical Self-Evaluation	Examines professional actions and instructional decisions	Generates reflective questions and analytical feedback	Development of critical reflective thinking
Improvement Planning	Determines future professional development goals	Recommends learning resources and improvement strategies	Individual professional development plan
Reflective Continuity	Monitors personal professional growth	Tracks reflective progress over time	Sustainable development of reflective competence

According to John Hattie, "Professional growth is strengthened through continuous feedback and reflection"[7]. This principle reinforces the proposed model, where reflective activities supported by artificial intelligence contribute to continuous professional improvement rather than isolated self-evaluation. The proposed model demonstrates that pedagogical reflection is a continuous developmental process rather than an isolated post-lesson activity. Each stage supports future teachers in transforming professional experience into meaningful learning opportunities while encouraging critical self-evaluation and continuous pedagogical improvement. As Stephen D. Brookfield notes, "Critical reflection helps teachers question assumptions and improve professional practice"[1]. This principle underpins the proposed model by emphasizing that reflective competence develops through systematic analysis, constructive feedback, and purposeful professional learning rather than through experience alone. Overall, the AI-Supported Pedagogical Reflection Model provides a practical methodological framework for integrating artificial intelligence into reflective teacher education. By combining reflective practice with intelligent technological support, the model contributes to the continuous professional growth of future primary school teachers and strengthens their ability to evaluate and improve their own instructional practice.

Discussion

The findings of this study demonstrate that artificial intelligence can significantly enrich the development of pedagogical reflection competence when integrated into teacher education through structured methodological principles. The proposed methodology extends traditional reflective practice by combining professional self-analysis with AI-supported feedback, enabling future primary school teachers to evaluate their instructional experiences more systematically and objectively. Rather than replacing reflective thinking, artificial intelligence creates additional opportunities for professional self-awareness and continuous improvement. This interpretation is consistent with the work of Donald Schön, who stated that "Professionals learn through reflecting on their actions"[7]. The proposed methodology expands this concept by demonstrating that AI-generated analytical feedback can enrich reflective processes without diminishing teachers' professional autonomy. Reflection therefore becomes a collaborative interaction between professional judgement and intelligent technological support. Another important contribution of the methodology is the integration of reflective practice into competency-based teacher education. Unlike conventional reflective activities that are often

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informal and unstructured, the proposed model organizes reflection into sequential stages supported by digital technologies. This systematic approach enables future teachers to monitor their professional development, identify recurring instructional challenges, and establish realistic goals for continuous improvement.

The findings also correspond to the recommendations of United Nations Educational, Scientific and Cultural Organization, which emphasizes that “AI should strengthen teachers' professional capacity while maintaining human agency”[6]. Within the proposed methodology, artificial intelligence functions as a reflective support tool rather than an evaluator, ensuring that professional interpretation and educational responsibility remain with the teacher. Although the proposed methodology offers a comprehensive framework for developing pedagogical reflection competence, its practical effectiveness should be examined through empirical implementation in different teacher education institutions. Future studies may investigate how AI-supported reflective activities influence professional self-awareness, reflective thinking, and instructional improvement among future primary school teachers. Overall, the proposed methodology demonstrates that integrating artificial intelligence with reflective pedagogy provides a promising direction for strengthening teacher education. By supporting continuous self-evaluation and professional learning, the methodology contributes to preparing reflective practitioners capable of responding effectively to the challenges of contemporary primary education.

Conclusion

This study proposed a methodology for developing the pedagogical reflection competence of future primary school teachers through artificial intelligence technologies. The methodology integrates reflective pedagogy, competency-based teacher education, and AI-supported reflective tools into a unified framework that promotes continuous professional learning and self-improvement. The proposed AI-Supported Pedagogical Reflection Model enables future teachers to document teaching experiences, analyse instructional practices, critically evaluate their professional performance, and develop individual improvement strategies. By incorporating artificial intelligence into reflective activities, the methodology enhances the quality of professional reflection while preserving teachers' independent judgement and responsibility. The findings suggest that AI-supported reflective practice contributes to strengthening reflective thinking, professional self-awareness, and lifelong learning competencies among future primary school teachers. Consequently, the proposed methodology may improve the quality of teacher education by encouraging systematic reflection and evidence-informed professional development.

Although the methodology provides a comprehensive conceptual framework, further empirical studies are required to evaluate its effectiveness in different teacher education contexts. Future research should investigate the influence of AI-supported reflective activities on teachers' professional competence, instructional effectiveness, and long-term professional growth. Overall, the proposed methodology offers an innovative approach to integrating artificial intelligence into reflective teacher education and provides theoretical and methodological foundations for developing reflective practitioners capable of meeting the challenges of modern primary education.

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