

Methodological Framework for Developing Creative Thinking of Future Teachers Through Interdisciplinary Abscissal And Ordinal Integration

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Abstract: This article proposes a methodological framework for developing creative thinking among future teachers through interdisciplinary abscissal and ordinal integration. The study substantiates the theoretical foundations of interdisciplinary interaction, competency-based education, and creative pedagogical development. A comprehensive framework integrating horizontal knowledge connections (abscissal integration) and vertical competency progression (ordinal integration) is developed to improve future teachers' professional competence. The research demonstrates that systematic interdisciplinary integration enhances creative problem-solving, reflective thinking, pedagogical innovation, and professional adaptability. The proposed framework provides practical guidance for improving teacher education curricula and contributes to the modernization of higher pedagogical education.

Keywords: Creative thinking, future teachers, interdisciplinary integration, methodological framework, competency-based education, teacher education, pedagogical innovation, reflective practice.

Introduction: The rapid transformation of modern education requires higher education institutions to prepare teachers capable of solving complex pedagogical problems creatively and independently. The transition toward competency-based education, digital transformation, and interdisciplinary learning has significantly increased the importance of creative thinking as a key professional competence of future teachers. Therefore, developing scientifically grounded methodological approaches that foster creative thinking has become one of the priority tasks of teacher education.

Recent educational reforms emphasize interdisciplinary learning as an effective strategy for preparing graduates who can integrate knowledge from different academic disciplines and apply it in professional practice. However, despite extensive studies devoted to creativity and teacher education, insufficient attention has been paid to methodological mechanisms that combine interdisciplinary integration with systematic competency development.

This study introduces an interdisciplinary methodological framework based on abscissal

integration, which ensures horizontal knowledge interaction, and ordinal integration, which provides sequential development of creative competencies. The proposed framework aims to strengthen future teachers' ability to generate innovative pedagogical solutions, conduct reflective practice, and adapt to rapidly changing educational environments.

The development of creative thinking has become one of the most actively discussed topics in contemporary educational research. International studies increasingly recognize creativity as a core competence required for successful professional activity in the twenty-first century. In teacher education, creative thinking is considered not only as an individual cognitive characteristic but also as an essential component of professional competence that enables future teachers to solve pedagogical problems effectively, design innovative learning environments, and continuously improve their instructional practice [2;5].

The competency-based approach has substantially influenced modern teacher education by shifting educational priorities from knowledge acquisition toward the development of transferable competencies. Researchers emphasize that future

teachers should possess analytical, reflective, communicative, and creative competencies simultaneously. Therefore, higher pedagogical education requires instructional models capable of integrating these competencies within a unified educational framework. Interdisciplinary integration has been identified as one of the most effective mechanisms for fostering higher-order thinking skills. Previous studies demonstrate that integrating knowledge from different disciplines enables students to establish meaningful conceptual relationships, transfer knowledge into new situations, and generate original solutions for complex educational problems. Nevertheless, existing models mainly focus on curriculum integration while paying insufficient attention to the methodological mechanisms that regulate the sequential development of creative competencies [1;4].

Recent investigations in educational psychology also indicate that creative thinking develops most effectively when students actively participate in authentic professional situations requiring critical analysis, collaboration, reflective practice, and innovative decision-making. Such educational environments stimulate divergent thinking, cognitive flexibility, and independent problem-solving abilities, which are considered fundamental indicators of creative competence. Although numerous studies investigate creativity, interdisciplinary learning, and teacher competence separately, comprehensive methodological frameworks combining these concepts remain limited. Most available approaches lack clear mechanisms explaining how interdisciplinary integration contributes to the systematic formation of creative competencies throughout teacher education programs. Consequently, there is a need for an integrative methodological model capable of connecting interdisciplinary knowledge with continuous professional development. The present study addresses this research gap by proposing a methodological framework based on two complementary dimensions of interdisciplinary interaction. The abscissal dimension represents horizontal integration of disciplinary knowledge, whereas the ordinal dimension ensures vertical progression of creative competencies during professional preparation. The interaction of these dimensions forms a dynamic methodological system supporting sustainable development of creative thinking among future teachers [3;4].

Unlike conventional interdisciplinary approaches, the proposed framework emphasizes not only curriculum integration but also the pedagogical mechanisms responsible for transforming integrated knowledge

into creative professional competence. This conceptual distinction constitutes the principal scientific contribution of the present research and provides a theoretical basis for improving contemporary teacher education programs. The research employed a mixed methodological approach combining theoretical analysis with empirical pedagogical investigation. The study was grounded in the principles of the competency-based approach, systems theory, learner-centered education, constructivist pedagogy, and interdisciplinary integration. These methodological perspectives provided a scientific basis for designing a comprehensive framework aimed at developing creative thinking among future teachers through interdisciplinary abscissal and ordinal integration [3;6].

The theoretical stage of the research involved an extensive review of contemporary literature related to creative thinking, interdisciplinary education, teacher professional competence, educational innovation, and pedagogical modeling. Scientific publications, monographs, doctoral dissertations, and methodological guidelines were comparatively analyzed, synthesized, and systematized to identify the essential structural elements of creative competence and determine methodological principles for its development. The empirical stage included pedagogical observation, questionnaires, diagnostic testing, expert evaluation, analysis of students' project activities, and reflective assessment. These methods enabled the comprehensive evaluation of future teachers' creative competencies and ensured the reliability of the obtained research findings [5;8].

To measure the effectiveness of the proposed framework, four interconnected dimensions of creative competence were selected:

- Motivational dimension – professional interest, intrinsic motivation, openness toward innovation, and willingness for continuous self-development.
- Cognitive dimension – interdisciplinary knowledge integration, analytical thinking, conceptual flexibility, and theoretical understanding of creative pedagogical activity.
- Operational dimension – ability to design innovative instructional solutions, apply interdisciplinary knowledge, solve authentic pedagogical problems, and organize project-based learning.
- Reflective dimension – self-evaluation, professional reflection, critical analysis of pedagogical decisions, and continuous improvement of teaching practice [4;9].

The proposed methodological framework is organized around two complementary dimensions.

The abscissal dimension represents horizontal interdisciplinary integration. It establishes meaningful conceptual relationships among pedagogy, psychology, subject methodology, educational technologies, digital pedagogy, and research methodology. Through this integration, future teachers learn to transfer knowledge across disciplines and solve pedagogical problems using multiple perspectives.

The ordinal dimension reflects the gradual vertical development of creative competence throughout professional preparation. Instead of considering creativity as a fixed personal characteristic, the framework conceptualizes creative competence as a developmental process progressing from reproductive learning toward independent pedagogical innovation. Each educational stage builds upon previously acquired competencies while introducing increasingly complex creative tasks and professional challenges [3;6].

Methodological Structure of the Proposed Framework

Framework Component	Main Characteristics	Expected Outcome	Educational
Abscissal Integration	Horizontal interdisciplinary knowledge connections	Integrated knowledge	professional
Ordinal Integration	Sequential competency development	Sustainable competence	creative
Creative Learning Activities	Projects, case studies, interdisciplinary tasks	Innovative thinking	pedagogical
Reflective Assessment	Portfolio, self-evaluation, expert assessment	Continuous growth	professional

Implementation of the framework was supported by interdisciplinary project assignments, creative pedagogical cases, collaborative learning, digital educational resources, reflective portfolios, and continuous formative assessment. These instructional strategies transformed students from passive recipients of information into active participants capable of generating original educational solutions and adapting knowledge to real professional contexts [2;6].

The methodological novelty of the proposed framework lies in integrating horizontal interdisciplinary knowledge construction with vertical competency progression within a unified pedagogical system. This dual-dimensional approach provides a scientifically grounded mechanism for systematic development of creative thinking throughout teacher education programs and extends existing theories of interdisciplinary pedagogy by introducing explicit methodological pathways linking curriculum integration with professional competence development. The implementation of the proposed methodological framework demonstrated significant improvements in the development of creative thinking among future teachers. Comparative analysis

conducted during the experimental stages indicated that interdisciplinary integration substantially enhanced students' ability to analyze educational problems, generate innovative instructional solutions, and apply professional knowledge in unfamiliar pedagogical contexts [3;7].

Initial diagnostic assessment revealed that most participants possessed satisfactory theoretical knowledge but experienced considerable difficulties when required to integrate knowledge from different disciplines for solving authentic educational problems. Their instructional decisions were predominantly based on reproductive thinking, while independent pedagogical creativity remained insufficiently developed. Following implementation of the proposed framework, substantial qualitative changes were observed across all dimensions of creative competence. Students became more capable of transferring interdisciplinary knowledge into practical teaching situations, designing innovative instructional strategies, and critically evaluating their own pedagogical performance. These improvements indicate that creative competence develops more effectively when interdisciplinary learning is systematically combined with reflective professional

practice [5;6].

Particularly noticeable progress was observed in collaborative project activities. Students working within interdisciplinary teams demonstrated greater flexibility in problem-solving, produced more original educational ideas, and showed stronger motivation toward professional self-development. Project-based learning encouraged active knowledge construction rather than passive information reproduction, thereby strengthening both creative and professional competencies.

The reflective component also showed remarkable development throughout the experimental period. Continuous self-assessment, portfolio preparation, peer evaluation, and reflective discussions enabled future teachers to recognize their strengths and weaknesses while planning further professional growth. Reflection therefore functioned not merely as an assessment instrument but as an essential mechanism supporting sustainable creative development [6;7].

Changes in Creative Competence after Framework Implementation

Creative Competence Dimension	Before Implementation	After Implementation
Motivation for Creative Activity	Moderate	High
Interdisciplinary Knowledge Integration	Low–Moderate	High
Creative Problem Solving	Moderate	High
Reflective Professional Practice	Low	High

The obtained findings support the assumption that creative thinking cannot be effectively developed through isolated instructional methods. Instead, sustainable development requires systematic interaction among interdisciplinary knowledge, innovative teaching methods, reflective practice, and competency-oriented assessment. The proposed framework successfully integrates these educational components into a coherent methodological system capable of improving teacher preparation. Comparison with previous international studies demonstrates that the proposed framework extends existing interdisciplinary approaches by introducing two complementary methodological dimensions. While most traditional models emphasize curriculum integration alone, the present framework simultaneously incorporates horizontal knowledge interaction (abscissal integration) and vertical competency progression (ordinal integration). This combination creates continuous developmental trajectories that promote long-term professional creativity rather than isolated creative performance [3;9].

The research findings also indicate practical implications for curriculum developers, teacher educators, and higher education institutions. Integrating interdisciplinary projects, reflective

assessment, creative case studies, and competency-oriented instructional strategies into teacher education programs may significantly improve graduates' readiness for innovative professional practice. Consequently, the proposed methodological framework represents not only a theoretical contribution but also a practical model applicable within contemporary higher pedagogical education. The findings of the present study confirm that the systematic development of creative thinking among future teachers requires an integrated methodological approach that combines interdisciplinary learning, competency-based education, and reflective professional practice. The proposed framework demonstrates that creative competence is not formed spontaneously but develops progressively through scientifically organized educational activities supported by continuous interdisciplinary interaction [2;3].

The research substantiated that abscissal integration serves as a methodological mechanism for horizontal knowledge interaction among pedagogy, psychology, subject methodology, educational technologies, and research methodology. Simultaneously, ordinal integration ensures the gradual vertical development of professional competencies from basic theoretical understanding toward independent pedagogical innovation. The combination of these two dimensions

constitutes the principal methodological contribution of this study and distinguishes the proposed framework from existing interdisciplinary models [5;7].

The empirical implementation of the framework demonstrated positive changes in all dimensions of creative competence. Future teachers participating in the experimental activities showed higher levels of interdisciplinary knowledge transfer, pedagogical creativity, professional reflection, collaborative problem-solving, and innovative instructional design. These findings indicate that interdisciplinary educational environments significantly contribute to preparing teachers capable of responding effectively to contemporary educational challenges. The proposed methodological framework possesses considerable practical value for higher pedagogical education institutions. Its implementation may improve curriculum design, strengthen competency-based instruction, enrich interdisciplinary collaboration, and promote sustainable professional development among future teachers. Furthermore, integrating project-based learning, creative case analysis, digital educational technologies, and reflective assessment into teacher education programs can substantially enhance instructional quality and graduate competitiveness [1;6].

From a theoretical perspective, the study contributes to the development of interdisciplinary pedagogy by introducing a dual-dimensional methodological model that integrates horizontal knowledge construction with vertical competency progression. This conceptual innovation expands existing theories of creativity development and provides a scientific foundation for further investigations into interdisciplinary teacher education.

Based on the research findings, the following recommendations are proposed:

- integrate interdisciplinary creative learning activities throughout teacher education curricula;
- develop competency-oriented instructional materials based on abscissal and ordinal integration;
- increase the use of project-based learning, creative case studies, and authentic pedagogical tasks;
- strengthen reflective assessment through portfolios, self-evaluation, and peer assessment;
- incorporate digital learning environments supporting interdisciplinary collaboration and creative problem-solving;
- establish continuous professional development programs focused on interdisciplinary pedagogy and creativity enhancement.

The proposed methodological framework may

therefore serve as an effective scientific and practical model for improving teacher education, promoting innovative pedagogical practice, and preparing highly competent professionals capable of addressing the educational demands of the twenty-first century.

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