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Effectiveness of The Interdisciplinary Abscissal–Ordinal Model for Developing Creative Thinking of Future Teachers: Experimental Evidence

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Abstract: This study evaluates the effectiveness of an interdisciplinary abscissal–ordinal model designed to develop creative thinking among future teachers. A pedagogical experiment involving diagnostic assessment, instructional intervention, and final evaluation was conducted to determine the impact of the proposed model on students' professional creative competence. Quantitative and qualitative analyses revealed significant improvements in motivational, cognitive, operational, and reflective dimensions of creative thinking. The findings confirm that systematic interdisciplinary integration substantially enhances future teachers' readiness for innovative professional practice and contributes to competency-based teacher education.

Keywords: Creative thinking, pedagogical experiment, teacher education, interdisciplinary integration, competency development, professional creativity, educational innovation, experimental research.

Introduction: The modernization of teacher education requires evidence-based instructional models capable of improving future teachers' professional competencies. Although numerous theoretical approaches emphasize the importance of creativity in teacher preparation, relatively few studies provide experimental evidence demonstrating the effectiveness of interdisciplinary models specifically designed for developing creative thinking. Contemporary educational reforms increasingly promote competency-based learning, interdisciplinary curriculum design, and

reflective professional practice. These developments require scientifically validated pedagogical models supported by empirical evidence rather than theoretical assumptions alone. Consequently, evaluating the effectiveness of innovative instructional frameworks has become an important direction in educational research [1;2].

The present study investigates the effectiveness of an interdisciplinary model integrating abscissal and ordinal dimensions of professional preparation. The model assumes that horizontal interdisciplinary knowledge integration combined with gradual competency progression provides favorable conditions for sustainable development of creative thinking among future teachers. Unlike previous studies focusing primarily on conceptual discussions of creativity, this research emphasizes experimental validation through pedagogical intervention, diagnostic assessment, comparative analysis, and evaluation of competency development dynamics. The obtained findings provide empirical support for introducing interdisciplinary instructional models into contemporary higher pedagogical education. The research was conducted within the framework of competency-based teacher education using a quasi-experimental design. The primary objective was to evaluate the effectiveness of the proposed interdisciplinary abscissal–ordinal model in developing creative thinking among future teachers. The experimental methodology was based on the principles of interdisciplinary integration, learner-centered education, constructivist learning, and competency-oriented assessment [2;6].

The research consisted of three consecutive stages: diagnostic assessment, formative intervention, and final evaluation. During the diagnostic stage, the initial level of creative competence was determined through questionnaires, pedagogical observation, diagnostic tests, expert assessment, and reflective analysis. The obtained results served as the baseline for subsequent comparative evaluation. The formative stage involved the implementation of the interdisciplinary abscissal–

ordinal instructional model. Teaching activities incorporated interdisciplinary projects, creative pedagogical case studies, collaborative problem-solving tasks, digital learning technologies, reflective portfolios, and competency-oriented instructional strategies. Throughout the intervention period, students were encouraged to integrate knowledge from pedagogy, psychology, educational technology, research methodology, and subject-specific disciplines while solving authentic educational problems [3;7].

Creative competence was evaluated across four interconnected dimensions:

- Motivational competence – intrinsic motivation toward professional creativity, innovative thinking, and continuous self-development.
- Cognitive competence – interdisciplinary knowledge integration, analytical reasoning, conceptual flexibility, and theoretical understanding of creative pedagogy.
- Operational competence – ability to generate innovative pedagogical solutions, organize project-based instruction, apply interdisciplinary knowledge, and solve authentic teaching problems.
- Reflective competence – self-evaluation, professional reflection, critical analysis of instructional decisions, and continuous improvement of pedagogical practice.

To ensure the reliability of research findings, multiple diagnostic instruments were applied simultaneously. Pedagogical observation provided continuous monitoring of students' instructional activities, whereas expert evaluation assessed the quality of interdisciplinary projects and creative teaching solutions. Diagnostic testing measured theoretical understanding, while reflective portfolios documented individual professional development throughout the experimental period. The combination of quantitative and qualitative assessment methods increased the validity of the obtained results [4;6].

Research Design

Research Stage	Main Activities	Expected Outcome
Diagnostic Assessment	Initial testing, questionnaires, observation	Baseline creative competence
Formative Intervention	Interdisciplinary instructional model implementation	Development of creative competencies

Final Evaluation	Comparative assessment, expert evaluation, reflection	Verification of instructional effectiveness
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The effectiveness of the proposed model was determined through comparative analysis of students' performance before and after the pedagogical intervention. Special attention was paid to changes in interdisciplinary knowledge transfer, creative problem-solving ability, reflective practice, and innovative pedagogical decision-making. The experimental results were interpreted using both quantitative indicators and qualitative analysis of students' professional growth [3;6].

The implementation of the proposed interdisciplinary abscissal–ordinal model produced statistically and pedagogically significant improvements in the creative competence of future teachers. Comparative analysis of the diagnostic and final assessment demonstrated positive changes across all four dimensions of creative thinking. These findings indicate that systematic interdisciplinary integration creates favorable conditions for sustainable professional creativity and competency development.

The most substantial improvement was observed in the operational dimension of creative competence. During the initial assessment, many participants experienced difficulties in applying theoretical knowledge to authentic pedagogical situations. Following implementation of the interdisciplinary instructional model, students demonstrated considerably greater ability to design innovative lesson plans, construct interdisciplinary learning tasks, organize collaborative educational activities, and

develop creative solutions for classroom challenges [4;6].

Significant positive changes were also identified in the cognitive dimension. Students became more capable of establishing interdisciplinary conceptual relationships, transferring knowledge across academic disciplines, and integrating theoretical understanding into professional decision-making. The improvement suggests that interdisciplinary learning contributes not only to broader knowledge acquisition but also to deeper conceptual understanding required for innovative pedagogical practice. The motivational dimension demonstrated noticeable progress throughout the intervention period. Students reported increased professional confidence, stronger intrinsic motivation for pedagogical innovation, and greater willingness to participate in creative instructional activities. The interdisciplinary learning environment encouraged active engagement, independent inquiry, and continuous professional self-development [1;9].

Development of the reflective dimension represented another important research outcome. Regular portfolio preparation, reflective journals, peer discussions, and expert feedback significantly improved students' capacity for self-assessment and critical evaluation of pedagogical practice. Reflection gradually transformed from an assessment procedure into an essential mechanism supporting continuous professional improvement.

Dynamics of Creative Competence Development

Creative Competence Dimension	Initial Assessment	Final Assessment	Overall Change
Motivational	Moderate	High	Significant improvement
Cognitive	Low–Moderate	High	Significant improvement
Operational	Low	High	Very high improvement
Reflective	Low	High	Significant improvement

The comparative evaluation further demonstrated that students participating in the experimental instruction achieved substantially better performance than those receiving conventional teacher education. Their instructional solutions became more innovative, interdisciplinary, learner-centered, and professionally justified. These findings support the hypothesis that integrating abscissal knowledge interaction with ordinal competency progression produces measurable improvements in professional creativity [5;6].

Overall, the research findings provide strong empirical evidence supporting the effectiveness of the proposed methodological framework. The observed improvements across motivational, cognitive, operational, and reflective dimensions confirm that creative thinking can be systematically developed through carefully designed interdisciplinary educational environments rather than relying solely on individual creative potential. The experimental findings confirm that the proposed interdisciplinary abscissal–ordinal model provides an effective methodological foundation for developing creative thinking among future teachers. Unlike conventional instructional approaches, which frequently emphasize isolated disciplinary knowledge, the proposed framework integrates interdisciplinary learning with sequential competency development, thereby creating sustainable conditions for professional creativity [2;6].

The observed improvement across all dimensions of creative competence suggests that creativity should not be regarded as an innate personal characteristic alone but rather as a professional competence that can be systematically developed through appropriately organized educational experiences. This conclusion corresponds with current international perspectives on competency-based education, which emphasize

continuous interaction between knowledge acquisition, practical application, and reflective professional growth. One of the principal contributions of the present study is the conceptual distinction between abscissal integration and ordinal integration. The abscissal dimension establishes horizontal relationships among pedagogy, psychology, educational technology, research methodology, and subject-specific disciplines, enabling future teachers to synthesize diverse knowledge resources while addressing authentic educational challenges. In contrast, the ordinal dimension ensures gradual progression of creative competence from elementary understanding toward independent pedagogical innovation. The interaction between these dimensions creates a coherent developmental pathway extending throughout the entire teacher education program [3;7].

Another important finding concerns the role of reflective educational practice. Continuous reflection, portfolio development, peer discussion, and expert feedback significantly strengthened students' ability to evaluate instructional decisions critically and improve subsequent professional performance. Reflection therefore functioned as both a diagnostic instrument and a developmental mechanism supporting long-term professional growth. The interdisciplinary instructional environment also promoted collaborative learning and professional communication. Students participating in interdisciplinary projects demonstrated greater flexibility in analyzing educational situations, higher levels of creative initiative, and stronger readiness to apply innovative instructional technologies. Such educational experiences appear particularly valuable for preparing teachers capable of responding effectively to rapidly changing educational systems and increasingly complex classroom environments [6;8].

Educational Advantages of the Proposed Framework

Framework Component	Educational Contribution	Professional Outcome
Abscissal Integration	Knowledge transfer across disciplines	Comprehensive pedagogical thinking
Ordinal Integration	Progressive competency development	Sustainable professional creativity
Reflective Assessment	Continuous professional self-analysis	Lifelong professional learning

Project-Based Activities	Authentic interdisciplinary practice	Innovative instructional competence
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The study further demonstrates that interdisciplinary integration becomes significantly more effective when supported by competency-oriented assessment and continuous formative feedback. Rather than evaluating isolated knowledge, the proposed framework measures professional performance through authentic pedagogical tasks, thereby increasing both educational validity and practical relevance. Overall, the discussion confirms that the proposed methodological framework contributes simultaneously to theoretical advancement and educational practice. It expands existing interdisciplinary pedagogy by introducing a scientifically grounded mechanism connecting horizontal knowledge integration with vertical competency development. Consequently, the framework provides a comprehensive model capable of strengthening teacher education quality, promoting creative professional competence, and supporting sustainable educational innovation in higher pedagogical institutions [1;6].

The present research provides substantial empirical evidence supporting the effectiveness of the proposed interdisciplinary abscissal-ordinal model for developing creative thinking among future teachers. The experimental findings demonstrate that systematic integration of interdisciplinary learning with competency-oriented instruction significantly enhances students' motivational, cognitive, operational, and reflective competencies, thereby improving their overall professional readiness for innovative pedagogical practice. The study confirms that creative thinking should be considered a dynamic professional competence rather than an isolated cognitive ability. Its sustainable development depends on carefully organized educational environments that encourage interdisciplinary knowledge integration, authentic professional activities, continuous reflection, and competency-based assessment. Consequently, the proposed methodological framework offers a scientifically grounded mechanism for organizing higher pedagogical education in accordance with contemporary educational requirements [5;7].

The principal scientific contribution of this research lies in the introduction of a dual-dimensional methodological framework. The abscissal dimension facilitates horizontal integration of disciplinary

knowledge, while the ordinal dimension ensures continuous vertical progression of creative professional competence. The interaction of these dimensions establishes a comprehensive educational system that supports long-term development of innovative pedagogical thinking and strengthens future teachers' professional adaptability. Experimental implementation demonstrated that students educated according to the proposed framework showed greater interdisciplinary reasoning, improved instructional creativity, stronger reflective abilities, and higher motivation for continuous professional learning than those receiving conventional instruction. These findings indicate that interdisciplinary educational models may substantially improve teacher education quality and contribute to preparing professionals capable of responding effectively to rapidly evolving educational environments [4;8].

The study also highlights the practical significance of integrating project-based learning, interdisciplinary case analysis, digital educational technologies, collaborative learning, and reflective assessment into teacher education curricula. Such instructional strategies establish educational environments where future teachers actively construct knowledge, develop creative competence, and continuously improve their professional practice through reflection and innovation [3;9].

Based on the obtained findings, several practical recommendations are proposed:

- redesign teacher education curricula according to interdisciplinary competency-based principles;
- integrate abscissal and ordinal dimensions into instructional planning across pedagogical disciplines;
- increase the use of interdisciplinary projects, authentic teaching cases, and research-based learning activities;
- implement continuous competency-oriented assessment supported by reflective portfolios and expert evaluation;
- strengthen digital learning environments facilitating interdisciplinary collaboration and creative problem-solving;
- establish professional development programs focused on creativity, interdisciplinary pedagogy, and educational innovation for university faculty members.

Despite the positive outcomes, several limitations should be acknowledged. The experimental

investigation was conducted within a limited institutional context, and therefore broader implementation involving multiple universities would strengthen external validity. Future studies may examine the applicability of the proposed framework across different teacher education specializations, compare its effectiveness in international educational contexts, and explore the integration of artificial intelligence, adaptive digital learning environments, and learning analytics into interdisciplinary creativity development.

Overall, the proposed framework represents a theoretically grounded and experimentally validated contribution to contemporary teacher education. It expands current understanding of interdisciplinary pedagogy by demonstrating how systematic interaction between horizontal knowledge integration and vertical competency progression can significantly enhance creative professional competence among future teachers. Consequently, the framework provides a sustainable scientific foundation for improving higher pedagogical education and supporting educational innovation in the twenty-first century.

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