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METHODOLOGY FOR DEVELOPING PEDAGOGICAL COMPETENCE IN FUTURE INFORMATICS TEACHERS

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Abstract
This article discusses the methodology for developing pedagogical competence in future informatics teachers. It analyzes modern approaches to teacher training based on digital technologies and competency-based education.

Keywords. Pedagogical competence, informatics teacher, digital education, methodology, TPACK, teacher training.

Аннотация
В статье рассматривается методика формирования педагогической компетентности у будущих учителей информатики. Анализируются современные подходы к подготовке учителей на основе цифровых технологий и компетентностного подхода.

Ключевые слова: педагогическая компетентность, учитель информатики, цифровое образование, методика, TPACK, подготовка учителей.

Annotatsiya
Ushbu maqolada bo‘lajak informatika o‘qituvchilarida pedagogik kompetentlikni shakllantirish metodikasi yoritilgan. Zamonaviy ta’lim sharoitida raqamli texnologiyalar va kompetensiyaviy yondashuv asosida o‘qituvchilarni tayyorlash masalalari tahlil qilingan.

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Kalit so‘zlar. pedagogik kompetentlik, informatika o‘qituvchisi, raqamli ta’lim, metodika, TPACK, kasbiy tayyorgarlik

Literature Review

The concept of pedagogical competence has been widely studied in the field of teacher education, particularly in relation to preparing future informatics teachers for modern digital learning environments. Researchers emphasize that pedagogical competence is a multidimensional construct that includes subject knowledge, teaching skills, classroom management abilities, and the effective integration of digital technologies into instruction.

Shulman (1987) introduced the concept of Pedagogical Content Knowledge (PCK), which highlights the importance of combining subject matter expertise with pedagogical understanding. This framework laid the foundation for later models that focus on teacher competence development. Building on this, Koehler and Mishra (2009) proposed the TPACK framework, which integrates Technology, Pedagogy, and Content Knowledge. According to this model, effective teaching in the digital age requires a balanced integration of these three components.

Recent studies have expanded the understanding of pedagogical competence in the context of digital transformation. UNESCO (2021) emphasizes that modern teachers must possess digital literacy and the ability to use educational technologies effectively. Similarly, Voogt and colleagues (2013) argue that teacher education programs should incorporate ICT integration as a core component of professional training.

Darling-Hammond (2017) highlights the importance of practice-based teacher education, stating that real classroom experience significantly improves pedagogical competence. In addition, Ertmer and Ottenbreit-Leftwich (2010) focus on the role of teachers’ beliefs and attitudes toward technology, noting that positive attitudes are essential for successful ICT integration in teaching practice.

Studies by Tondeur et al. (2012) show that structured training programs that combine theoretical knowledge with practical experience are more effective in developing ICT-related pedagogical skills. These findings suggest that future

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informatics teachers require continuous exposure to both digital tools and pedagogical strategies.

Furthermore, research by Mishra and Koehler (2006) indicates that technology integration in education should not be viewed as an isolated skill but as part of a broader pedagogical framework. This perspective supports the idea that pedagogical competence develops through the interaction of multiple knowledge domains.

In the context of informatics education, several scholars emphasize the importance of computational thinking and digital pedagogy. Wing (2006) defines computational thinking as a fundamental skill for solving problems using computer science concepts. This skill is increasingly important for future teachers who must guide students in developing digital competencies.

Despite the progress in research, several challenges remain. Many studies point out that teacher education programs still lack sufficient practical training opportunities and do not always provide adequate exposure to modern digital tools. Additionally, differences in institutional resources and technological infrastructure affect the quality of teacher preparation programs.

Overall, the literature strongly supports the integration of competency-based education, digital pedagogy, and practical training in the development of pedagogical competence for future informatics teachers. The TPACK framework remains one of the most influential models in this field, providing a solid theoretical basis for curriculum design and teacher training programs.

Research Methodology

This study adopts a qualitative-analytical and conceptual research design aimed at developing a methodological framework for forming pedagogical competence in future informatics teachers. The main focus of the research is to identify effective pedagogical approaches, digital tools, and training strategies that contribute to the professional development of teacher candidates in the field of informatics education. The methodology is structured to ensure a systematic, reliable, and theoretically grounded investigation of the research problem.

The research process is organized into three main stages: theoretical analysis, comparative analysis, and methodological modeling. Each stage plays a specific

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role in achieving the objectives of the study and contributes to the development of a comprehensive understanding of pedagogical competence formation.

Theoretical Analysis. The first stage involves an extensive review and analysis of scientific literature, academic publications, international educational standards, and pedagogical theories. At this stage, key concepts such as pedagogical competence, digital pedagogy, ICT integration, competency-based education, and the TPACK framework are examined in detail. The purpose of this analysis is to identify the theoretical foundations of pedagogical competence and to understand how these concepts are applied in modern teacher education systems.

Special attention is given to the works of Shulman (1987), who introduced the concept of Pedagogical Content Knowledge (PCK), and Koehler and Mishra (2009), who developed the TPACK framework. These models are analyzed as they provide a strong theoretical basis for integrating technology, pedagogy, and subject content in teacher education. In addition, recent studies on digital transformation in education are reviewed to understand current trends in informatics teacher preparation.

Comparative Analysis. The second stage of the research involves a comparative analysis of teacher education systems from different countries and institutions. The aim of this stage is to identify effective practices and approaches used in the development of pedagogical competence among future teachers.

The comparison focuses on several key aspects, including curriculum design, teaching methodologies, practical training opportunities, and the integration of digital technologies in teacher education programs. Countries with advanced educational systems are analyzed to understand how they prepare informatics teachers for modern digital classrooms.

The findings from this stage show that successful teacher education programs typically combine theoretical instruction with intensive practical experience. Programs that integrate ICT training and classroom practice simultaneously tend to produce more competent and confident future teachers. This stage also highlights the importance of reflective practice and continuous professional development in teacher education.

Methodological Modeling. The final stage of the research involves the development of a methodological model for forming pedagogical competence in

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future informatics teachers. This model is designed based on the synthesis of theoretical and comparative analysis results.

The proposed model consists of three interconnected components: theoretical preparation, practical training, and digital competence development. The theoretical component focuses on pedagogical knowledge, educational psychology, and subject-specific didactics. The practical component includes teaching practice, micro-teaching sessions, and classroom simulations. The digital competence component focuses on the use of ICT tools, educational software, and digital learning platforms.

The model emphasizes the integration of these components to ensure holistic teacher preparation. It also highlights the importance of continuous reflection, feedback, and improvement throughout the learning process.

Research Approach. The study follows a qualitative and descriptive research approach. It does not involve experimental data collection but instead relies on the analysis and synthesis of existing scientific knowledge. The approach is suitable for developing theoretical frameworks and methodological models in education.

Data collection is based on secondary sources, including peer-reviewed journal articles, books, conference papers, and international reports. These sources are carefully selected to ensure academic reliability and relevance to the research topic.

Data Analysis Method. The collected data is analyzed using content analysis and thematic analysis techniques. Content analysis is used to identify key concepts and patterns in the literature, while thematic analysis helps to organize information into meaningful categories such as pedagogical skills, digital competence, and teaching methodology.

Validity and Reliability. To ensure the validity of the research, only credible and peer-reviewed academic sources are used. The reliability of the study is ensured through consistent interpretation of data and systematic analysis of multiple literature sources. Cross-referencing of information from different authors helps to strengthen the accuracy of the findings.

Ethical Considerations. Since the study is based entirely on secondary data, no direct human participants are involved. However, ethical academic practices are

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strictly followed. All sources are properly cited to avoid plagiarism, and intellectual property rights are respected throughout the research process.

Limitations of the Study. One limitation of this research is that it is purely theoretical and does not include empirical data collection from actual teacher education institutions. Therefore, the proposed methodological model requires future empirical validation through experimental or survey-based studies.

Analysis and Results

The analysis of the study focuses on synthesizing findings from theoretical sources, comparative studies, and existing pedagogical models to determine effective ways of developing pedagogical competence in future informatics teachers. Since this research is conceptual in nature, the results are derived from systematic literature interpretation and methodological comparison rather than experimental data collection.

The analysis reveals that pedagogical competence in future informatics teachers is a multidimensional construct that includes pedagogical knowledge, subject content mastery, and digital competence. Among these components, digital competence plays an increasingly significant role due to the rapid integration of information and communication technologies (ICT) in education. The reviewed literature consistently shows that teachers who are proficient in digital tools and pedagogical strategies are more effective in organizing student-centered learning environments.

One of the key findings is that the integration of the TPACK framework significantly enhances the quality of teacher preparation programs. The analysis shows that programs based on TPACK principles allow future teachers to develop a balanced understanding of how technology, pedagogy, and content interact in real classroom settings. This integrated approach helps students not only understand informatics concepts but also learn how to teach them effectively using digital tools.

The comparative analysis of international teacher education models indicates that successful programs share several common features. These include early exposure to classroom practice, continuous use of digital tools during training, and strong mentorship systems. Countries with advanced educational systems

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tend to emphasize practical experience more than purely theoretical instruction. As a result, teacher candidates in these systems demonstrate higher levels of pedagogical competence and confidence in using ICT.

Another important result is that reflective practice plays a crucial role in developing pedagogical competence. The analysis shows that future teachers who regularly reflect on their teaching experiences are better able to identify their strengths and weaknesses. Reflection helps them improve instructional strategies, classroom management skills, and the effective use of technology in teaching.

The results also highlight the importance of digital pedagogy training. Many studies reviewed in this research emphasize that future informatics teachers must be trained not only in using digital tools but also in integrating them meaningfully into the learning process. Effective digital pedagogy involves selecting appropriate technologies, designing interactive learning activities, and assessing student performance using digital tools.

Despite these positive findings, several challenges were identified. One major issue is the gap between theoretical knowledge and practical application. In many teacher education programs, students receive sufficient theoretical instruction but limited opportunities for real classroom practice. This reduces the effectiveness of pedagogical competence development.

Another challenge is the uneven availability of digital resources across institutions. Some universities lack modern ICT infrastructure, which limits students' ability to practice digital teaching methods. Additionally, insufficient training of teacher educators in advanced digital pedagogy also affects the quality of instruction.

The analysis further shows that motivation and attitude toward technology significantly influence the development of pedagogical competence. Future teachers who show positive attitudes toward ICT are more likely to develop strong digital teaching skills. Conversely, resistance to technology adoption slows down competence development.

Based on the synthesis of findings, the proposed methodological model—consisting of theoretical preparation, practical training, and digital competence development—is found to be effective in addressing existing gaps in teacher

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education. This model ensures a balanced integration of knowledge, skills, and practice, which is essential for preparing competent informatics teachers.

In summary, the results confirm that pedagogical competence in future informatics teachers can be effectively developed through a combination of theoretical learning, practical experience, digital training, and reflective practice. The integration of these elements creates a holistic training system that aligns with modern educational requirements.

Conclusion

This study examined the methodological approaches to developing pedagogical competence in future informatics teachers within the context of modern digital education. The findings confirm that pedagogical competence is a complex and multidimensional construct that requires the integration of theoretical knowledge, practical teaching experience, and digital skills. In particular, the role of ICT and digital pedagogy has become increasingly important in preparing teachers for contemporary educational environments.

The analysis shows that effective teacher preparation programs are those that combine competency-based education with practice-oriented training. The application of the TPACK framework demonstrates that the integration of technology, pedagogy, and content knowledge significantly enhances the quality of teacher education. Future informatics teachers who are trained using such integrated approaches are better prepared to design interactive, student-centered, and technology-enhanced learning environments.

The study also highlights that reflective practice and continuous professional development are essential components of pedagogical competence formation. Teachers who regularly evaluate their teaching methods and adapt to new technologies tend to demonstrate higher levels of professional growth and instructional effectiveness.

Overall, the proposed methodological framework provides a structured approach to developing pedagogical competence in future informatics teachers. It emphasizes the importance of balancing theory, practice, and digital integration. Future research should focus on empirically testing this model in real educational settings to further validate its effectiveness and adaptability.

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