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IMPROVING THE SOFTWARE AND METHODOLOGICAL SUPPORT FOR PREPARING FUTURE INFORMATICS TEACHERS FOR INDEPENDENT RESEARCH ACTIVITIES

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Abstract:
This article examines the importance of enhancing software and methodological support in preparing future informatics teachers for independent research activities. As digital technologies become an integral part of modern education, the demand for educators who are capable of conducting research, analyzing data, and applying innovative approaches to teaching is increasing. The study focuses on developing a comprehensive framework that integrates digital tools, pedagogical strategies, and methodological principles to support students' research competencies. Based on an analysis of the current educational standards and the experience of pedagogical institutions in Uzbekistan, the article proposes several improvements in instructional design, digital content development, and interactive research platforms. The goal is to ensure that pre-service teachers in the field of informatics are equipped with the skills, tools, and methodologies needed for productive and autonomous scholarly inquiry.

Keywords: independent research, informatics teacher education, methodological support, software tools, digital pedagogy, pedagogical training.

Introduction

Informatics education plays a critical role in shaping students' digital literacy, computational thinking, and problem-solving abilities. The rapid advancement of

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information technologies has transformed both the content and methodology of teaching, demanding a new generation of teachers who are not only technically competent but also capable of engaging in independent research. Future informatics teachers must possess the ability to explore, analyze, and synthesize information through self-directed inquiry. However, the current teacher education curricula often lack sufficient emphasis on the systematic development of independent research skills, particularly in relation to the use of digital tools and methodological resources.

Independent research activity is essential for cultivating reflective thinking, innovation, and lifelong learning. For prospective informatics teachers, it means being able to design and carry out educational experiments, assess digital learning environments, and evaluate the effectiveness of instructional technologies. Despite its importance, many students struggle to engage in meaningful research due to limited methodological training and a lack of well-integrated software support within the educational process. This disconnect underscores the urgent need to rethink how independent research competence is fostered in teacher preparation programs.

Enhancing software and methodological support requires a multifaceted approach that combines curriculum design, instructional strategies, and access to interactive platforms and digital environments. This includes the integration of specialized research software, digital libraries, collaborative tools, and platforms for data collection and analysis. Such resources not only facilitate practical research experiences but also help students internalize key aspects of scientific inquiry. The purpose of this article is to investigate the pedagogical and technological aspects of preparing future informatics teachers for independent research and to identify effective strategies for improving the software and methodological infrastructure that supports their development.

Literature Review

Recent studies in the field of teacher education emphasize the growing importance of fostering research competence among future educators, particularly in STEM-related disciplines such as informatics. Scholars such as Mishra and Koehler (2006) have highlighted the significance of technological, pedagogical,

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and content knowledge (TPACK) in shaping effective teaching practices in digital environments. Within this framework, the integration of research-oriented digital tools becomes essential for enabling pre-service teachers to navigate and contribute to knowledge-based education systems.

A number of researchers have also drawn attention to the challenges faced by informatics students in developing independent research skills. According to Yelland (2011), traditional instructional models do not adequately support the exploratory and constructivist learning necessary for research activity. Moreover, Tondeur et al. (2017) suggest that teacher preparation programs should incorporate active learning strategies, including project-based learning and digital inquiry models, to promote autonomy and innovation in future educators.

In the context of informatization in education, the role of software support systems has been widely acknowledged. Digital tools for literature review, data analysis, visualization, and collaboration are increasingly viewed as indispensable components of teacher education (Voogt & Roblin, 2012). Nonetheless, there remains a gap between theoretical approaches and practical implementation, indicating a need for better-aligned instructional designs and targeted methodological resources to fully realize the potential of independent research training.

Methodology

The methodological approach of this study is based on a qualitative analysis of existing teacher education practices and technological support systems used in the preparation of future informatics teachers. The research employed a case study method to examine selected pedagogical institutions that incorporate elements of independent research training into their informatics teacher education programs. Data were collected through document analysis, expert interviews, and classroom observations, focusing on the alignment between curriculum content, digital infrastructure, and students' research activities.

The study examined how future informatics teachers engage with various software tools, such as data visualization applications, simulation platforms, programming environments, and online research repositories. Special attention was paid to the pedagogical strategies employed by instructors to scaffold

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students' independent inquiry, such as guided research assignments, peer-reviewed projects, and the use of digital portfolios. The methodological framework also involved evaluating the accessibility and usability of the software systems employed, assessing whether they met the cognitive and functional needs of students at different stages of their academic training.

Furthermore, the study incorporated principles from the design-based research (DBR) methodology, which allows iterative testing and refinement of instructional models in real educational settings. By integrating feedback from both students and instructors, the research aimed to propose adaptable and context-sensitive improvements to the software and methodological components of research training. The focus remained on identifying scalable strategies that enhance not only technical competencies but also the reflective and analytical dimensions of teacher professionalism.

Discussion

The findings of the study reveal several critical gaps in the current approaches to preparing future informatics teachers for independent research activities. One of the primary issues identified is the fragmented integration of digital tools within the curriculum. While individual courses may introduce students to specific applications or platforms, there is often no coherent strategy that systematically supports the development of research competence across the program. This lack of continuity hinders students from forming a holistic understanding of the research process, leading to superficial engagement with research tasks.

Another important observation relates to the insufficient methodological support provided to students. Many pre-service informatics teachers struggle with formulating research questions, designing studies, and applying appropriate analytical techniques. These challenges are frequently exacerbated by the limited availability of user-friendly research software tailored to the educational context. Instructors, in turn, may lack the training or institutional backing to effectively guide students through the complexities of digital research, further weakening the impact of research-oriented coursework.

Moreover, students often perceive independent research as a purely academic requirement rather than a meaningful professional practice. This perception

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reflects broader cultural and pedagogical issues, including the dominance of reproductive learning and exam-centered assessment systems. To shift this mindset, it is essential to embed research tasks into authentic, problem-based learning scenarios that mirror real-world challenges informatics teachers are likely to face. For instance, research projects could involve the evaluation of digital learning environments, the design of educational software, or the analysis of student data to inform teaching decisions.

Interactive research platforms and collaborative digital tools offer significant potential for enhancing student engagement. Platforms such as Google Workspace, Miro, Overleaf, and data analysis environments like Jupyter Notebooks and RStudio can be effectively integrated into teacher education to facilitate real-time collaboration, iterative feedback, and data-driven reflection. However, their use requires careful instructional design and ongoing technical support to ensure pedagogical coherence and accessibility for all learners.

Ultimately, the discussion suggests that improving software and methodological support must be viewed not as isolated interventions but as an integrated component of curriculum reform. Successful implementation requires institutional commitment, professional development for teacher educators, and continuous dialogue between academic, technical, and administrative stakeholders. Only through such a comprehensive strategy can independent research be positioned as a central pillar in the formation of competent, innovative, and reflective informatics educators.

Main part

The preparation of future informatics teachers for independent research requires a strategic combination of theoretical foundations, practical experiences, and technological infrastructure. To achieve this, it is essential to reconsider the current structure of teacher education programs by embedding research skills into the core components of academic training. A holistic approach involves revising curriculum standards, enhancing instructional methods, integrating digital tools, and ensuring continuous feedback and reflection throughout the learning process.

First, curriculum development must prioritize the gradual and systematic formation of research competence. This means introducing research concepts

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early in the program and progressively building students' abilities to formulate questions, gather and analyze data, and interpret findings within pedagogical contexts. Courses such as educational research methods, instructional technology, and data literacy should not only cover theoretical aspects but also include hands-on, project-based assignments that simulate real-life educational scenarios. These experiences cultivate autonomy, critical thinking, and decision-making—skills essential for successful independent inquiry.

Second, the integration of specialized software tools plays a vital role in supporting students' research activities. Modern teacher education must include access to tools for data collection (e.g., Google Forms, SurveyMonkey), statistical analysis (e.g., SPSS, R), and content organization (e.g., Zotero, EndNote). Equipping students with these tools helps them work more efficiently and develop familiarity with the digital instruments used in both academic and professional environments. Furthermore, platforms that allow for collaborative research, such as cloud-based document editors and discussion boards, promote peer learning and collective knowledge building.

Third, methodological training should be reinforced through targeted workshops, seminars, and mentorship programs. Instructors should act as research facilitators, guiding students in the formulation of research problems, the selection of methodologies, and the ethical conduct of inquiry. Institutions should establish research support centers or units that provide students with consultation, resources, and infrastructure to pursue their independent projects. These centers can also host annual student research conferences, promoting scholarly engagement and academic exchange.

Fourth, it is crucial to create an assessment system that values research efforts and outcomes. Traditional examinations do not adequately reflect students' abilities to engage in meaningful research. Instead, alternative assessment methods—such as portfolios, case studies, poster sessions, and reflective journals—should be incorporated. These forms of assessment encourage deeper learning and provide a more accurate representation of students' progress in developing research competence.

Finally, the digital environment itself must be designed to support independent inquiry. Learning management systems (e.g., Moodle, Google Classroom) should

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include dedicated sections for research activities, resource sharing, and peer feedback. Instructors should curate digital libraries and repositories where students can access academic literature, datasets, and example research projects. With structured access to digital resources, students are better positioned to pursue research topics that are relevant, data-driven, and pedagogically meaningful.

In sum, the main body of this article emphasizes the multifaceted nature of preparing informatics teachers for independent research. It requires systemic change across curriculum design, technological infrastructure, pedagogical methods, and institutional culture. Only through the deliberate and sustained integration of these elements can teacher education programs produce professionals who are not only knowledgeable in informatics but also capable of leading educational innovation through research-based practice.

Conclusion

The capacity to engage in independent research is a cornerstone of professional competence for future informatics teachers. As education systems become increasingly reliant on technology and data-informed practices, it is imperative that teacher preparation programs equip their students with the necessary skills, tools, and methodological foundations to carry out effective and meaningful inquiry. This article has highlighted the existing shortcomings in software integration, instructional support, and curriculum coherence that hinder the development of research competence among pre-service informatics educators.

To address these issues, the study proposed a comprehensive strategy that includes the early introduction of research components into the curriculum, the integration of specialized software tools, the enhancement of methodological training, and the creation of supportive digital environments. These measures, when implemented together, provide a solid foundation for cultivating independent researchers who are capable of critically engaging with educational challenges and contributing to pedagogical innovation.

Moreover, improving software and methodological support is not merely a technical upgrade but a pedagogical imperative that requires institutional commitment, interdisciplinary collaboration, and continuous feedback from both

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students and educators. Only through such a holistic and sustainable approach can we ensure that future informatics teachers are well-prepared to navigate the complexities of the digital learning environment and foster evidence-based teaching practices in their future careers.

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