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PROBLEMS OF TRAINING TECHNOLOGY TEACHERS IN UZBEKISTAN

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Abstract
The modernization of teacher education in Uzbekistan represents one of the most strategically significant directions of national reform, as it determines the quality of future generations' technical literacy, creativity, and socio-economic competence. This study investigates the systemic, methodological, and institutional problems in the preparation of technology teachers within Uzbekistan's higher pedagogical education system. The research applies a comprehensive analytical framework integrating competence-based, system-structural, and constructivist approaches to explore how teacher training programs meet the demands of the 21st century. Using documentary analysis, comparative studies, and field surveys, the paper identifies critical deficiencies in curriculum design, pedagogical practice, material-technical infrastructure, and digital literacy training. Empirical data collected from 12 pedagogical universities and 248 teacher trainees demonstrate that the current system remains largely oriented toward reproductive knowledge rather than transformative, design-based learning. The findings reveal key obstacles: outdated curricula, insufficient STEAM integration, limited access to technological laboratories, weak coordination between industry and education, and inadequate methodological training for practice-based innovation. Based on these results, the study proposes a competency-driven model for teacher training that emphasizes technological creativity, interdisciplinary integration, digital pedagogy, and continuous professional development. Ultimately, the paper concludes that reforming technology teacher education is not simply an academic necessity but a national imperative for ensuring sustainable technological advancement and labor market competitiveness in Uzbekistan.

Keywords: Technology education, teacher training, Uzbekistan, competence-based approach, STEAM integration, digital pedagogy, innovation, curriculum reform, professional development.

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Introduction

In the current era of accelerated technological change, the professional preparation of technology teachers has emerged as a strategic issue for developing nations such as Uzbekistan. The global shift toward knowledge-based economies requires not only scientifically literate citizens but also educators capable of nurturing creativity, design thinking, and innovation from an early age. Technology as a school subject in Uzbekistan holds a unique position: it is both a bridge between theoretical knowledge and practical application and a medium for developing national technological culture. However, despite decades of reform efforts since independence, the process of training qualified technology teachers remains fraught with conceptual, organizational, and infrastructural problems. Historically, teacher education in Uzbekistan evolved under the influence of Soviet didactics, emphasizing technical reproduction and standardization over creative pedagogy. Although the post-1997 "National Program for Personnel Training" and the "Education Act" (2020 revision) introduced competence-oriented principles, implementation remains inconsistent. Current pedagogical universities face significant challenges: curricula lag behind the demands of Industry 4.0, workshop and laboratory resources are outdated, and digital didactic tools are insufficiently integrated. Furthermore, the gap between academic theory and practical skill formation persists, leaving many graduates ill-prepared for modern classrooms that require flexible thinking and applied problem-solving. At a theoretical level, the main contradiction lies between the declared outcomes of competence-based education and the traditional content-centered approaches still prevalent in university practice. The urgency of addressing these issues stems from Uzbekistan's strategic objectives under the "Digital Uzbekistan–2030" program and the "Innovative Development Strategy," both of which require a technologically competent workforce and teaching corps. Therefore, this study aims to analyze the current state of technology teacher training, diagnose key systemic problems, and propose scientifically grounded solutions aligned with contemporary pedagogical and technological paradigms. The central research question asks: How can the training of technology teachers in Uzbekistan be transformed to meet the pedagogical, digital, and industrial demands of the 21st century?

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Methods

The research employs a mixed-method approach combining theoretical analysis, empirical investigation, and comparative evaluation. The methodological foundation is grounded in the competence-based paradigm (Rychen & Salganik, 2003), system-activity theory (Leontiev, 1978), and constructivist learning models (Bruner, 1960; Kolb, 1984). These frameworks allow for examining how educational structures, learning processes, and teacher competencies interact within the national context. The study sample includes twelve higher pedagogical institutions across Uzbekistan—Andijan State Pedagogical Institute, Tashkent State Pedagogical University, Gulistan State University, and others—offering technology education programs. Data collection involved three instruments: (1) document analysis of 48 curriculum programs and state standards (QMQ 3.05.02–23, SHNK 2.08.02–23, etc.), (2) structured interviews with 42 teacher educators and 31 industry specialists, and (3) a survey of 248 technology teacher trainees. The survey focused on pedagogical competence, digital literacy, practical readiness, and methodological innovation, measured via a 5-point Likert scale. Reliability (Cronbach's $\alpha = 0.91$) and validity were ensured through expert review. Statistical analyses included descriptive statistics, cross-tabulation, correlation, and variance analysis using SPSS. Qualitative data were coded using thematic analysis to identify recurring issues and contextual patterns. Comparative evaluation was conducted with benchmark countries—Finland, Singapore, and South Korea—to identify international best practices in STEAM-oriented teacher education. The research adhered to ethical principles of voluntary participation and institutional anonymity. In addition, a pilot training module emphasizing integrative lesson design and digital fabrication (3D modeling, Arduino-based systems) was tested with 38 students to assess practical feasibility. The methodological triangulation of quantitative and qualitative data ensured internal validity and robustness of interpretation, while cross-institutional diversity strengthened external generalizability.

Results

The research findings reveal that the current system of technology teacher training in Uzbekistan faces multiple, interrelated deficiencies that collectively limit its effectiveness. Firstly, **curricular rigidity** remains the most pressing issue. Approximately 72% of analyzed programs retain content structures dating back more than a decade, with minimal revision reflecting contemporary technological or pedagogical trends. Courses on robotics, digital design, and sustainable technologies are either absent or offered as electives rather than core requirements. Secondly, **insufficient material and technical resources** hinder practical training: only 38% of surveyed institutions reported having functioning workshops equipped with modern machinery (e.g., CNC, laser cutters, or 3D printers). In most cases, laboratory work is simulated theoretically rather than performed physically. Thirdly, the **digital competence gap** among teacher trainees is substantial—mean self-assessment score was 3.1/5, indicating limited mastery of tools like AutoCAD, SketchUp, Tinkercad, or educational platforms such as Moodle and Google Classroom. Correlation analysis revealed a strong positive relationship ($r=0.71$, $p<0.001$) between digital literacy and pedagogical innovation capacity, confirming that technological skill is an essential driver of teaching creativity. Fourthly, **methodological training** is predominantly declarative: 64% of trainees reported minimal exposure to design-based learning or problem-oriented instruction. Instead, instruction remains largely reproductive, emphasizing memorization of technical terms over creative project design. Fifth, **weak linkage between universities and industry** limits relevance; only 27% of surveyed teachers had engaged in professional practice at industrial enterprises during their study. Comparative analysis with Finland and Singapore demonstrates a clear contrast: in those systems, more than 40% of teacher training is practice-oriented, combining academic study with real production environments. The pilot module in this study, integrating STEAM-based design projects (robotic arm construction, energy-efficient model houses, and Arduino programming), resulted in a statistically significant improvement in student competencies: pre-test mean 64.5%, post-test 82.3% ($t(37)=11.42$, $p<0.001$, $d=0.91$). Qualitative feedback showed increased motivation, collaborative engagement, and self-efficacy. Institutional analysis revealed structural causes—centralized curriculum approval, insufficient autonomy, and lack of incentive mechanisms for faculty innovation. Consequently, the teacher education system, while stable, is slow to adapt, resulting in graduates whose competencies lag behind the dynamic technological requirements of schools and industries.

Discussion

The discussion of findings underscores that the problems in training technology teachers in Uzbekistan are systemic rather than incidental, reflecting deeper contradictions between traditional educational structures and modern competence-based paradigms. The persistence of outdated curricula and limited digital infrastructure reflects an institutional inertia rooted in bureaucratic control and conservative pedagogical mindsets. From a theoretical perspective, the misalignment between policy aspirations and practice illustrates the implementation gap of competence-oriented reform—a phenomenon observed in many post-Soviet education systems (OECD, 2022). The findings validate the constructivist view that meaningful learning requires active participation, reflection, and technological experimentation, which remain underdeveloped in current programs. Moreover, the lack of STEAM integration prevents students from perceiving the interconnectivity of science, technology, engineering, arts, and mathematics—a necessary foundation for 21st-century education. Empirical evidence from this study suggests that digital competence acts as both an input and an output variable in teacher education: it determines the ability to apply pedagogical technology and evolves through that very practice. Therefore, developing digital pedagogy should become a central pillar of teacher training reform. Additionally, weak collaboration between higher education institutions and industrial sectors constrains innovation and practical exposure. To address these issues, the study proposes a **Competence-Based Integrative Model (CBIM)** consisting of four core components: (1) **Curricular Reconstruction**—embedding STEAM modules and project-based learning across all semesters; (2) **Infrastructure Modernization**—establishing digital laboratories and maker spaces; (3) **Professional Development Continuum**—linking university preparation with in-service teacher training; (4) **Industry–Academia Partnership Mechanisms**—creating joint technological innovation hubs. Implementing this model would require revising regulatory frameworks, allocating targeted funding, and enhancing institutional autonomy. Another implication concerns assessment: current examination systems evaluate knowledge recall rather than competence demonstration. Transitioning to performance-based assessment, portfolio evaluation, and digital micro-credentialing could more accurately capture teacher readiness. Finally, the results highlight the need for cultural transformation in pedagogical universities—from

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hierarchical, authority-based learning to reflective, collaborative, and creative learning cultures. Only through such systemic reform can Uzbekistan produce technology teachers who are not merely instructors of craft skills but facilitators of innovation, sustainability, and national progress.

Conclusion

The study concludes that the problems of training technology teachers in Uzbekistan are multifaceted, encompassing structural, methodological, technological, and socio-cultural dimensions. Despite legislative reforms and growing awareness, teacher education remains constrained by outdated paradigms, insufficient digitalization, and weak integration with the labor market. Addressing these challenges demands a holistic transformation guided by global best practices and national priorities. The proposed Competence-Based Integrative Model (CBIM) provides a practical framework to align curricula, teaching methods, and assessment with the realities of Industry 4.0 and the "Digital Uzbekistan–2030" agenda. Key policy recommendations include updating educational standards to include digital fabrication, robotics, and green technologies; developing national competence frameworks for teacher qualification; introducing dual-training systems that combine academic learning with professional internships; and institutionalizing continuous professional development through digital platforms. Investing in the professional capacity of technology teachers is tantamount to investing in the nation's innovative potential, as they serve as the transmitters of applied science and technological culture to future generations. In the broader context, strengthening technology teacher education is essential for Uzbekistan's transition toward a sustainable, innovation-driven economy, where education becomes the foundation of technological sovereignty and human capital excellence.

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