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Trategic Factors for Developing Professional Competencies of a Technology Teacher in the Modern Educational Paradigm

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Abstract: This article analyzes the conceptual foundations for the development of professional competencies of technology teachers in the context of the changing modern educational paradigm. The study highlights the new requirements for the professional training of future and current teachers, skills in working with digital technologies, and strategic factors that foster creative thinking. The author justifies the pedagogical and organizational conditions that contribute to enhancing the professional skills of teachers in the modernization of technology education.

Keywords: educational paradigm, technology subject, professional competence, strategic factors, transformation, pedagogical skills, innovative activity, professional development.

Introduction. Globally, the demands of the Fourth Industrial Revolution (Industry 4.0), which emerged as a result of the technological revolution at the end of the 20th and the beginning of the 21st centuries, have set new strategic tasks for all social institutions, particularly the education system. In the Republic of Uzbekistan, modernizing the education system, directing its content towards the formation of digital competencies, and raising national education standards to the level of international requirements are among the priority tasks in this regard. In Uzbekistan, where the Digital Uzbekistan national program is being implemented and education is being rapidly digitized, technology teachers play a significant role in preparing students for the innovation economy.

Indeed! The rapid development of globalization and digital technologies is placing entirely new tasks before the education system. The role and significance of the Technology subject have fundamentally changed in modern education, which is based on personalized and technological approaches, moving away from the traditional education model. Now, this subject is not limited to teaching simple practical skills, but has become a key element in shaping engineering thinking, creativity, and technological culture in students. In such a responsible environment, the professional competence development of technology teachers is emerging as a critical pedagogical issue. Teachers are required not only to have pedagogical skills but also to be adaptable to the constantly changing technological environment and to have innovative thinking skills. Your article's detailed analysis of the strategic factors that determine the professional development of teachers in the transformation processes in education and the scientific foundations for their implementation is very important.

This process fundamentally changes the requirements for Technology teachers. Instead of traditional labor education methods, there is a need to introduce digital pedagogy that requires

teaching modern fields such as Computational Thinking, robotics, data analysis, and the ethics of artificial intelligence, which is a pressing issue.

However, developing teacher competencies is not just about organizing courses, but a multi-stage process regulated by a complex ecology of internal and external factors. The purpose of this article is to conduct a deep scientific analysis of the main factors that directly affect the development of the professional competencies of the Technology teacher in the context of the transformation of the education system at the systemic, institutional, and individual levels. By identifying these factors, education policymakers and school administrations can create effective and scientifically based interventions aimed at increasing the professional potential of teachers.

Main Body: Detailed Analysis of Influencing Factors. In the modern education paradigm, the development of professional competencies for technology teachers depends on several important strategic factors. First and foremost, a high level of technological and digital literacy is a key factor. Today's teacher must be able to integrate not only manual labor or traditional processing methods, but also 3D modeling, robotics, and elements of artificial intelligence into the educational process. In this process, the integration of pedagogical activity with technical capabilities is a key strategic direction that enhances the professional reputation of the teacher.

The second important factor is the axiological approach, that is, the professional values and personal motivation of the teacher. In a transformation environment, a teacher should be a person who is constantly working on self-development and is oriented towards independent learning. Professional competence is not just a collection of knowledge, but the ability to make independent decisions in complex situations and find innovative solutions to problems.

A third strategic factor is creative and project-based thinking. Technology is inherently based on project work. Instead of giving students ready-made knowledge, the teacher should teach them to research and solve problems based on the STEM (science, technology, engineering, and mathematics) approach. This requires the teacher to have project management skills.

Also, socio-communicative competencies are an important strategic factor, which is manifested in the teacher's ability to establish effective communication with students, parents, and employers, to work in a team, and to create a psychologically comfortable environment in the educational environment. The renewal of the content of education requires the teacher to be adaptable and skillfully apply new pedagogical technologies (for example, Flipped Classroom or Blended Learning).

In recent decades, the problem of knowledge, which traditionally falls within the scope of philosophy, has also received serious attention in the field of technical sciences. Serious changes are taking place in the education system of Uzbekistan within the framework of the Digital Uzbekistan (2030) national strategy aimed at integrating information and communication technologies (ICT) into the educational process. The subject Technology, which includes elements of engineering, design, and innovation, is a key method for developing STEM skills in students. However, teachers of this subject must constantly update their competencies to effectively use digital tools. It is known that professional competencies include: technical knowledge (working with CAD programs, 3D printing), pedagogical skills (adaptation to hybrid education), and the ability to combine interdisciplinary approaches.

In the context of educational reforms being implemented in Uzbekistan through the Digital Uzbekistan program, the impact of digital technologies on the professional competencies of Technology teachers can be justified using a number of pedagogical, psychological, and technological theories.

The professional competencies of teachers include cognitive (knowledge), affective (motivation), and behavioral (practical skills) aspects, and they are enhanced by the impact of ICT. Theoretically, this technology facilitates the transition from traditional pedagogy to interactive

pedagogy, increases the effectiveness of teaching, and enhances the adaptation of teachers to modern requirements.

It should be emphasized that the development and improvement of personal-professional competencies of Technology teachers is not a linear process, but occurs through the complex influence of internal and external forces. In conditions of systemic transformation (often caused by technological disruptions and revisions of national educational standards, such as the introduction of computational thinking (CT)), these factors become a decisive lever of change.

I. Systemic and Political Factors: Macro-Level Environment

Systemic factors relate to national, regional, or government policies that define the overall framework, funding, and consistency for technology education.

1. Consistency of National Digital Education Policy

The theoretical justification for the impact of digital technologies on the professional competencies of Technology teachers can be carried out based on the following approaches:

1. Competency-based approach and TPACK model. This approach defines competencies as the integration of knowledge, skills, and values necessary for effective performance.

When digital technologies are applied to teachers, it expands this spectrum by adding digital competence, which includes the skills to use ICT for pedagogical purposes. To justify this, the TPACK (Technological Pedagogical Content Knowledge, Koehler & Mishra, 2009) model is the most important.

It describes the interaction of three types of knowledge (technological, pedagogical, and the subject being taught). In the context of the Technology subject (which includes engineering design, robotics, and innovation), digital tools (such as CAD programs like AutoCAD or local analogs in Uzbekistan) improve TPACK by allowing teachers to integrate technology into teaching. Empirical studies show that developing TPACK significantly increases the teaching effectiveness of technology teachers.

In local practice, where teachers often face resource scarcity, technology reduces barriers: online platforms (Moodle, integrated into the UzEdu system) allow for personalized learning, developing teachers adaptability and creativity.

Theoretically, this aligns with the constructivist learning theory, where technology acts as a zone of proximal development, stimulating teachers' cognitive growth through active interaction.

A clear, long-term national strategy for digital education is the foundation for developing teacher competencies. This strategy must go beyond simply providing computers; it must define pedagogical goals related to the use of technology (e.g., student-centered learning, project-based assessment).

- Clear Policy Alignment: Vague or frequently changing policies lead to teacher confusion and unwillingness to invest time in new skills. Effective policies provide clear competency frameworks (e.g., UNESCO ICT-CFT or DigCompEdu), offering teachers a roadmap for professional development.
- Funding Commitment: Systemic funding ensures the fair distribution of digital resources and stable funding for high-quality, long-term Professional Development (PD) programs. Without dedicated, guaranteed funding, institutional efforts remain fragmented and ineffective.

2. Curriculum Integration and Balance. The curriculum must require the application of modern technologies and pedagogies. Transformation requires changing the role of the teacher from delivering prescribed material to facilitating students' knowledge discovery and construction using digital tools.

- Horizontal and Vertical Integration. Competencies should be developed with the aim of integrating technology not only in technology class but throughout the curriculum (horizontal integration) and ensuring a logical progression of skills from elementary to high school (vertical integration). This requires the Technology teacher to become an interdisciplinary mentor.

3. Continuity of Teacher Training and Professional Development

A persistent factor hindering professional development is the gap between Initial Teacher Education (ITE) and Continuing Professional Development (CPD).

- Bridging the Gap: Systemic reform should ensure that ITE programs provide a strong fundamental understanding of Technological Pedagogical Content Knowledge (TPACK) principles. If ITE lags behind, CPD is forced into remedial education, which wastes time and resources that should be dedicated to advanced competency development.
- Accreditation and Standards: Accreditation and professional standards policies should be regularly updated to reflect the current demands of the digital classroom, linking certification and promotion to demonstrated mastery of new digital and ethical competencies.

II. Institutional and Contextual Factors: The School Ecosystem

These factors relate to the school's immediate environment, resources, and culture, which either support or restrict the practical application of new competencies.

1. Digital Infrastructure and Technical Support

The physical and logistical environment is a major obstacle (often referred to as First-Order Barriers). Even the most advanced teacher training will fail if the tools are unusable or unreliable.

- Reliability and Access: Teachers need guaranteed access to working equipment, strong network connectivity, and specialized software. Developing competencies in areas such as educational robotics or data visualization is impossible without the appropriate physical and digital infrastructure.
- Human Technical Support: The presence of technical support staff in the school reduces the burden on teachers, freeing them from troubleshooting and allowing them to focus on pedagogical applications. Lack of support causes stress and reduces the ease of technology use.
- I agree completely. Having technical support staff available in schools is incredibly important. It really does lighten the load for teachers, freeing them up from troubleshooting tech issues so they can concentrate on how to best use technology in their lessons. When that support isn't there, it just adds to the stress and makes it harder for teachers to feel comfortable using technology. It's a key factor in making technology integration successful.

2. School Leadership and Visionary Management

The leadership team creates and supports the institutional conditions for change.

- Leading by Example and Advocacy: School leaders should not only promote technology integration but also participate in professional learning themselves to understand the challenges and opportunities. Their vision should align technology use with the school's overall educational goals, clearly articulating why changes are necessary.
- Resource Allocation: Leaders must strategically allocate budget for dedicated technology resources, dedicated PD time (e.g., half days for planning), and release from teaching load to develop new learning materials.

3. Collaborative Culture and Professional Learning Communities (PLCs)

Professional growth is deeply social. Isolated practice hinders the spread of innovation.

- Embedded Collaboration: Effective competency development is maximized when it occurs within Professional Learning Communities. These communities enable technology teachers to share resources, co-plan lessons, observe colleagues, and receive context-specific, immediate feedback.
- Interdisciplinary Collaboration: The role of the technology teacher is enhanced when they collaborate with teachers of other subjects (Science, Arts, Humanities) to develop interdisciplinary projects, embodying a philosophy of integration rather than isolation of technology.

4. Quality of Professional Development Program

Institutional PD programs should adhere to adult learning principles to ensure high transferability to the classroom.

- Sustained and Long-Term: The impact of short, one-off training events is minimal. Effective development should continue over weeks or months, including observation coaching, mentoring, and opportunities for reflective practice.
- Active and Practice-Oriented: Courses should be active, requiring teachers to design lessons, practice new techniques with student-relevant content, and analyze the results, moving away from simply passively receiving information (Research often cites a minimum threshold of 30 hours for behavioral change).

III. Individual and Subjective Factors: The Teacher's Role

These factors relate to the teacher's internal state, representing Second-Order Barriers—psychological states, beliefs, and motivations—which are more difficult to overcome than resource constraints.

1. Teacher Self-Efficacy and Beliefs about Technology

A teacher's belief in their ability to successfully execute a course of action is the single most powerful predictor of the adoption of new methods.

- Self-Efficacy: Low digital self-efficacy leads to avoidance of challenging technological tasks, regardless of external resources. PD programs should be designed to foster successful early experiences, using techniques such as modeling, successful early experiences, and verbal persuasion to boost confidence.

For example, from a psychological perspective, digital technologies influence teachers' impactful competencies through self-determination theory, where autonomy, competence, and relatedness are enhanced.

In 'Technology' subjects, the use of ICT (e.g., VR simulators to demonstrate engineering processes and online tools) increases motivation. In Uzbekistan, such technologies allow 'Technology' teachers to automate daily tasks, freeing up time for creativity.

Cognitive Load Theory explains how technology optimizes learning: interactive platforms reduce extraneous cognitive load, allowing learners to focus on subject-matter competencies.

For teachers in Uzbekistan, especially in rural areas, this creates a 'digital bridge, ensuring equal educational opportunities.

- Pedagogical Beliefs: A teacher's fundamental belief in student-centered learning must align with the demands of digital pedagogy. Teachers with traditional, content-delivery beliefs are more likely to use technology only to automate old practices (e.g., digital worksheets) rather than transform teaching.

2. Adaptability, Flexibility, and Resilience (Growth Mindset)

Given the rapid rate of technological obsolescence, the ability to constantly adapt is a core competency in itself.

- Embracing Change: Technology teachers should possess a Growth Mindset, viewing technical challenges and evolving tools not as threats but as essential opportunities for professional growth. They should be comfortable with the concept of 'perpetual beta' in their practice.
- Investing Time and Effort: Developing advanced competencies (such as teaching coding or data analysis) requires significant personal time and mental effort. A teacher's intrinsic motivation to invest this effort is a critical factor in successful competency development.

3. Reflective Practice and Critical Thinking

The development of high-level professional competence relies on a teacher's ability to critically analyze their own practice and the impact of the technology they are using.

- Critiquing Technology: Technology teachers should develop competencies in critically evaluating digital tools for their pedagogical effectiveness, ethical implications, and suitability for diverse learners, moving beyond vendor hype.
- Metacognition: Reflective journaling, video analysis of lessons, and post-lesson discussions allow teachers to bridge the gap between theoretical knowledge gained in professional development (PD) and the complex reality of classroom practice, thereby strengthening new professional competencies.

Thus, these technologies significantly improve the professional competencies of Technology teachers in schools, promoting innovation in education. Further use of these technologies should include the development of digital literacy modules that further enhance mandatory professional competencies in professional development programs and the establishment of regional support centers focused on rural areas.

Conclusion. In conclusion, the development of professional competencies of a technology teacher in the modern educational paradigm is a multifaceted process that represents a synthesis of personal, technological, and methodological factors. Correctly identifying strategic factors and implementing them into educational practice will raise the quality of technology education to a new level. The professional development of a teacher is not only their individual effort but also a product of a systematic approach, continuous professional development, and a modern innovative environment. Taking these strategic factors into account is crucial in improving the system of training future technology teachers and ensuring their competitiveness. In a transforming educational system, the professional development of a Technology teacher is a highly interdependent process. This is achievable when systemic factors ensure clear and fair policy direction; institutional factors provide the necessary resources, time, and a culture of collaboration; and individual factors contribute key elements of motivation, self-confidence, and a commitment to continuous learning.

For education systems to realize the transformational potential of technology, policymakers and school administrators must shift their focus from simply purchasing technology to empowering teachers. By strategically designing interventions that recognize and proactively address all three categories of factors—ensuring the availability of technical infrastructure, promoting embedded learning, and cultivating teacher's digital self-efficacy—it is possible to sustain the development of highly competent technology teachers, ultimately ensuring students' readiness for a complex digital future.

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