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RESEARCH ARTICLE

A System for Developing the Professional and Graphic Competence of Future Teachers of Technological Education Based on An Integration Approach

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Abstract

The article highlights the system of professional graphic competence development of future teachers of technological education based on an integration approach in theoretical and practical aspects. The content of professional graphic training, the didactic possibilities of an integration approach to its formation, as well as the effectiveness of the educational process based on interdisciplinary connections are analyzed. The role of the use of information and communication technologies, multimedia tools and practical training in mastering graphic activity is also shown. The stages, pedagogical conditions and methodological support for the development of professional graphic competence of future teachers have been developed. The results acquire scientific and practical significance for the modernization of the technological educational process, the formation of graphic culture and the improvement of the effectiveness of teachers' professional activities.

KEYWORDS

Integration, integration approach, education system, interdisciplinary connections, pedagogical process, quality of education, graphic activity, multimedia tools, didactic possibilities.

INTRODUCTION

Ensuring innovative and sustainable development requires improving the quality of higher pedagogical education. For this purpose, the goals, outcomes, content, and technologies of training future teachers are being updated in line with the competency-based approach, which is recognized as a leading educational paradigm worldwide. The outcome of the educational process based on the competency model of specialist training is socio-professional competence.

In the context of the growing role of graphics in the information society and modern education, graphic competence constitutes an essential component of the socio-professional competence of future teachers. It can be defined as a personal quality expressed through the ability and willingness to use computer technologies effectively. The formation of graphic competence for solving professional problems represents one of the stages of mastering graphic culture as an integral part of universal human culture and the development of a scientific worldview.

The maturity of graphic competence determines the effectiveness of a teacher's instructional, educational, developmental, and value-oriented activities. Students' graphic training contributes to the development of their intellectual and cognitive abilities, as well as their professional and personal qualities and needs. The relevance of the

problem of developing graphic competence among future teachers is also обусловлена its insufficient elaboration in both the theory and practice of professional education, as most existing studies are limited to technical and technological education fields.

The formation of graphic competence in future teachers requires scientific and theoretical research in several key areas, including: defining the structure and content of graphic competence; developing a system of graphic instruction aimed at its development; and diagnosing its effectiveness.

Taking into account modern realities, recent efforts have been made to model a pedagogical system capable of preparing future innovative teachers within the framework of professional education.

The structure of the system for professional training of future teachers includes:

- priority goals aimed at achieving a high level of professional mastery;

- principles and content focused on mastering the components of professional training, including integrated professional knowledge, skills, and competencies formed as psychological, pedagogical, and specialized (computer-based) abilities;

- pedagogical conditions that ensure the effectiveness of implementing the professional orientation of pedagogical activity, including methods, forms, tools, monitoring and correction mechanisms, as well as outcomes that reflect changes achieved in accordance with the established goals.

Pedagogical activity comprises several types, including instructional, educational, production-technical, organizational-pedagogical, and professional-pedagogical activities. Within learning-cognitive activity, the main components include design, implementation, and analysis; the development and use of production and technical teaching tools, as well as equipment maintenance; organizational and pedagogical activity involves team management and the economic functioning of educational institutions; professional-pedagogical activity encompasses organizational, economic, and operational functions.

The core components of the professional competence of innovative teachers are identified as motivational, personal, cognitive, and operational. Each component includes a set of individual competencies, which can be regarded as the fundamental competencies of a future teacher.

During the research, the individual psychological characteristics, professional knowledge, graphic competence, and professional qualities underlying the professional-graphic competence of future technology education teachers were identified. The development of professional-graphic competence in higher education institutions requires the application of systemic, activity-based, and competency-based approaches as a foundational basis for professional training.

The essence of competence lies in its reflection of educational content that includes the ability to solve production and technical problems, perform core functions, and carry out design and engineering roles and tasks. In our view, an activity-based approach to competence formation enhances the practical orientation of the educational process by developing a combination of theoretical knowledge, skills, and practical experience. It also involves a clear understanding of the goals and objectives of professional activity, activation of independent practice-oriented actions, and the evaluation of the level of competence formation.

The motivational component includes competencies such as the development of scientific and pedagogical thinking, the formation of innovative thinking, and readiness to implement information technologies.

The personal component is expressed through the need for continuous education, self-development, and self-improvement; the ability to demonstrate personal creative potential in organizing innovative activities; and students' social activity in the implementation of information technologies in practice.

The cognitive component is characterized by a system of knowledge that includes natural sciences, humanities, and specialized disciplines, as well as knowledge of modern educational information technologies. The operational component, in turn, primarily encompasses the ability to organize innovative activities within specific types of teaching practice, to develop information culture, and to apply information technologies in both theoretical and practical contexts.

The general objective of studying disciplines within the field of technological education is to develop professional and graphic culture and literacy, to foster spatial thinking, and to cultivate creative abilities for analyzing and synthesizing spatial forms and relationships based on their graphical representation. It also involves the development of constructive thinking skills.

The main tasks of such disciplines include:

- developing the ability to understand information presented in graphical form, such as drawings, diagrams, charts, and schemes;

- developing the ability to express one's ideas, plans, and concepts in the form of drawings, sketches, graphic models, and similar representations.

In the context of mass communication and the growing need to integrate large volumes of information with the new capabilities of information and communication technologies (ICT), the requirements for general graphic education—often regarded as a form of "second literacy"—have significantly increased. Consequently, the issue of developing graphic competence among future teachers, and thus modernizing this component of teacher training in technological education, has become highly relevant.

In our view, graphic competence can be defined as an essential personal characteristic that reflects the ability to understand the functional and structural features of technical objects and to consciously apply experience-based graphic knowledge, skills, and abilities. It also implies the capacity for effective orientation within a professional environment supported by graphic information technologies.

Considering the development of graphic competence among future teachers, it includes a комплекс of elements such as graphic knowledge and skills, cognitive abilities (critical, visual-spatial, technical, and creative thinking), communication skills, methodological abilities, independence, and a positive attitude toward the profession. Ultimately, these components collectively form the structure of graphic competence.

In our view, graphic competence can be defined as a set of fundamental graphic knowledge and skills that are continuously enriched through creativity in conjunction with self-development and self-improvement, as well as emotional intelligence.

At the current stage of studying the problem of graphic competence, its insufficient theoretical and methodological elaboration places a number of important tasks before researchers, including:

- identifying the specific features of forming graphic competence in future teachers;

- improving the structure, components, indicators, criteria, and levels of graphic competence;

- substantiating the pedagogical conditions necessary for the formation of graphic competence among future teachers;

- designing and experimentally testing the formation of graphic competence under specific pedagogical conditions.

In contemporary society, the ability to interact with modern technologies is essential for professionals across all sectors. In a market economy, specialists are required not only to use technologies at a basic level but also to achieve high efficiency and, when necessary, adapt and configure these technologies to meet the specific needs of different professional domains.

Considering that modern computing systems and computer-aided design (CAD) tools are largely based on graphic methods, it can be concluded that human–technology interaction is primarily built upon graphical interactive interfaces. Consequently, this necessitates the inclusion of graphic competence as an integral component of professional competence.

Application (by domain): Graphic competence, which is one of the most important professional competencies of specialists—particularly those working in engineering and technological fields—is primarily formed within the framework of disciplines such as Technical Drawing, Engineering Graphics, and Computer Graphics, as well as a range of specialized courses.

Within the scope of this study, the content of this competence was analyzed and conditionally categorized into four main areas of application:

Representation – the use of graphics for visualizing and presenting information to enhance clarity and comprehension;

Object identification – the use of graphical interpretation to extract relevant information for a specific domain;

Design – the use of graphic competencies by specialists in engineering and design fields to construct models of planned objects;

Modeling – the use of graphics for improving, refining, and transforming newly created models and representations.

Manifestation of indicators across disciplines:

The application of the above-mentioned graphic competencies in all four domains was analyzed within the curricula of students enrolled in the programs 5112100 – Technological Education and 60112300 – Technological Education. These

competencies were examined across various compulsory and elective (specialized and general professional) subjects.

Within this analysis, the manifestation of students' graphic competence was identified through specific indicators. For example, students demonstrate indicators of graphic competence in the representation domain through:

- the ability to read electronic circuit diagrams in the course Electrical Engineering, Electronics, and Electric Drives;

- understanding knitting схемалар (patterns), including the trajectory of needles or hooks and thread movement in the course Technology of Hand Knitting;

- interpreting graphic organizers and effectively applying the above skills in practice in the course Methodology of Technology Education.

Within the object identification domain, the manifestation of indicators of graphic competence is determined through students' abilities developed in disciplines such as Technical Drawing, Practicum in Technology Education, Hydroautomatics, Technical Mechanics, Modern Techniques and Technologies, and Industrial Production Technologies. These indicators include the ability to use technological maps, create drawings and graphs, perform technical calculations based on drawings, understand kinematic schemes, and read technical documentation.

Within the design domain, indicators of students' graphic competence are demonstrated through their ability to construct projections in the course Engineering Graphics; to develop technological maps in Design of Technological Processes; to create artistic decorations and patterns, as well as acquire sewing skills in Folk Crafts and Artistic Design; and to produce diagrams and graphical representations in Mechatronics and Automated Systems.

Within the modeling domain, indicators of graphic competence are reflected in the development of spatial thinking skills and practical abilities acquired through disciplines such as Product Manufacturing Technology, Fundamentals of Robotics, Automated Systems for Garment Design and Modeling, Technical Creativity and Construction, Fundamentals of Creative Engineering Activity, and 3D Modeling. These include the ability to construct and develop patterns in garment design, transform two-dimensional (2D) drawings into three-dimensional (3D) representations, and automate the processing of graphical data.

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