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TECHNOLOGY FOR DEVELOPING FUTURE SOFTWARE ENGINEERS' COMPETENCE THROUGH PEDAGOGICAL SOFTWARE TOOLS

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Abstract
This article explores the scientific and methodological foundations of forming professional competence in future software engineers through the use of pedagogical software tools. It analyzes the possibilities of developing students' professional competencies in a modern educational environment based on individual approaches, cluster strategies, interactive teaching technologies, and digital platforms. The study also examines the integration of programming languages into the educational process, ensuring interdisciplinary connections, and enhancing independent learning.

Keywords. pedagogical software tools, professional competence, software engineer, cluster approach, individual learning, digital learning environment, programming languages, interdisciplinary connections, innovative technologies, independent learning.

Introduction

Currently, the widespread implementation of information and communication technologies across all sectors of society is placing new demands on the higher education system as well. In particular, one of the key issues in technical higher education institutions is the preparation of future software engineers as highly qualified specialists equipped with modern knowledge and skills. In a digital learning environment, the effective use of pedagogical software tools contributes to integrating students' theoretical knowledge with practical applications, developing independent learning skills, and fostering their professional competencies.

In contemporary education, a student-centered approach has become a priority. The learner's motivation, self-directed effort, interest in independent learning, and commitment to professional development are considered key factors determining the quality of education. Therefore, the use of innovative technologies, e-learning

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platforms, and pedagogical software tools is of great importance in preparing future software engineers.

Mechanisms and principles of forming a modern student personality, along with their scientific foundations, as well as achieved practical and methodological results, contribute to increasing the effectiveness of their successful implementation by professors and teachers. This, in turn, leads to significant positive changes in students' personal lives.

The practical mechanism for improving the quality of education consists of the following components:

1. A system for organizing modern lessons based on an individualized approach.
2. A teaching strategy based on the cluster approach.
3. An individual learning trajectory for working with students.
4. Improving the quality of education through an individualized approach to the student's personality.

The psychological requirements of the innovative cluster for developing the professional training of future software engineers consist of the following:

1. Competencies for personal growth in education.
2. The concept of "lifelong learning."
3. Social mobility.

The problem of developing the professional training of future software engineers cannot be solved without meeting the modern requirements imposed on teaching and learning processes. The rapid changes in societal demands are creating the necessity to adapt classroom instruction in educational institutions to these requirements. In our view, modern lessons are directly dependent on the following factors:

1. Description and instructional technology of the lesson.
2. Competencies being formed.
3. The learning process and its stages.
4. Consolidation and independent learning.

The description and instructional technology stage is one of the initial components of a lesson. It encompasses the modern relevance of goals and objectives, the orientation of key concepts toward developmental outcomes, the determination of the educational and pedagogical significance of the teaching process, as well as its interrelated content with methods, forms, and instructional tools.

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Formed competencies: algorithmization, modeling, programming, design, construction, and automation.

The learning process and its stages:

1. Organizational stage.
2. Reflection.
3. Presentation of the topic.
4. Motivation and encouragement.

Consolidation and independent learning:

1. Homework assignments.
2. Independent tasks.
3. Development of practical application skills (competence).

When comparing traditional and modern lessons, it becomes clear that these two concepts differ in the following aspects (Table 1).

Table 1. Differences between traditional and modern lessons

Traditional lesson	Modern lesson
- Organizational stage; - Questioning (oral survey); - Explanation of new material; - Consolidation; - Homework assignment	- Organizational-motivational stage; - Survey and knowledge activation; - Goal setting; - Studying new material through interaction; - Initial consolidation of new material; - Ongoing assessment and evaluation of student activity; - Corrections (remediation); - Generalization and systematization; - Instructions for homework (individualization, differentiation, and providing choice opportunities); - Lesson summary (reflection)

Cluster-based teaching strategy. This strategy consists of the following components: problem-based work; classificatory methodologies; social order (social demand); integration; specialized processes; and open educational content.

As problems related to the cluster approach, the following issues can be considered: professional competence, pedagogical algorithm, and integration. Each of these concepts has its own necessary description and meaning within an educational environment based on cluster collaboration. The contextual meaning of these concepts is clarified through pedagogical analysis, synthesis, diagnosis, pedagogical consilium, and modification methodologies, and they serve as important tools aimed at solving the problem.

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Objects and subjects, the integration of intellectual potential and infrastructure represent a process of mutual interpenetration and harmonization, which reflects an integration process based on the cluster approach. This emerges in ensuring the alignment of State Educational Standards (SES), curricula, and qualification requirements across different levels of education.

Within the framework of this strategy, the unified mobile information space of cooperation between higher education institutions and production entities, as well as the electronic collaboration policy of these subjects aimed at improving educational quality around common goals, constitutes open educational content.

In open educational content, the conveyor-based conditions of teaching academic disciplines can be defined as follows: goal-setting — establishing a forecasted topic objective with guaranteed outcomes; content — ensuring that the subject matter corresponds to the student profile; distribution — proper allocation of learning process stages; coordinated methodology — selection of appropriate forms, methods, and tools in accordance with the topic and its characteristics; didactic support — organizing conditions for independent learning and study skills development; pedagogical technique — enhancing the professional training of future software engineers within the learning process.

In the cluster-based teaching strategy, the cluster catalyst refers to a set of factors that influence the elimination of problems, while cluster attributes are associated with content related to consilium, motivator, corrector, mentor, realizer, and pedagogical clinic.

The individual learning trajectory of students (Figure 1) is directly related to the following factors in shaping a modern student personality: the mentor–apprentice system, distance learning, independent learning, blended learning, as well as individual forms of work and planning.

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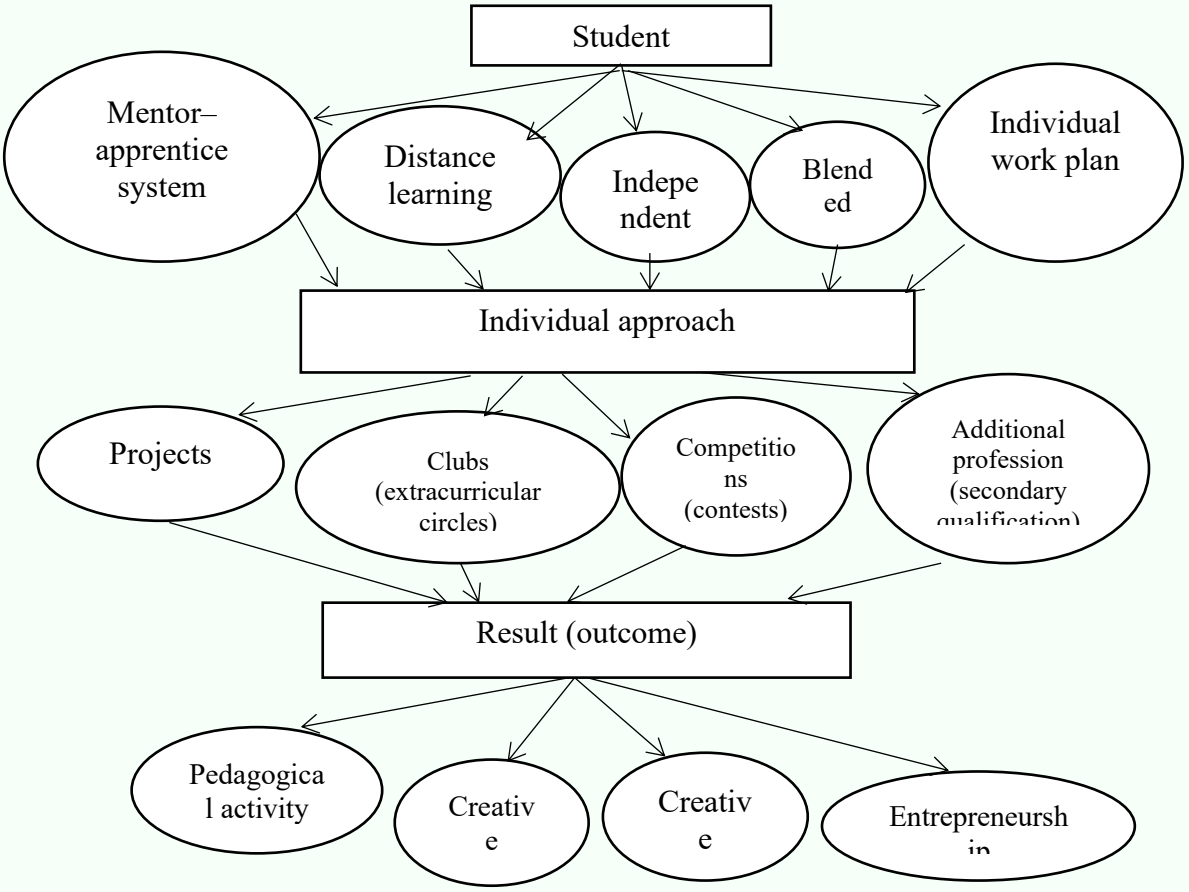

Figure 1. Individual learning trajectory for working with students

Likewise, it is expedient that the mechanisms for developing the professional training of students based on an individual approach consist of the following components: personalized learning plans; individual pedagogical approach; skills development; mentoring and advisory services; individual assessment and feedback; use of innovative educational technologies; self-assessment and self-development; motivation and encouragement.

1. Goal. From the perspective of forming a specific understanding in the student, it is necessary for them to possess the following aspects to a certain degree: 1) defining their own interests. This helps the student determine what they should engage in and what personal qualities they need to develop; 2) setting goals while considering their own character. Such goals increase motivation and enhance personal energy; 3) finding ways to facilitate the implementation of goals. For example, students may establish personal rules, set tasks, and create daily schedules; 4) preparing an action plan; 5) identifying motivators that constantly remind them of the importance of their goals. This strengthens motivation and guides the student to work consistently

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without difficulties; 6) defining what reward they will receive as a success outcome in the process of achieving their goals. This increases motivation and helps the student understand the impact of achieving their objectives.

2. Self-assessment. In this component, the student evaluates their own characteristics, strengths and weaknesses, interest in learning, and other personal aspects. This encourages them to take necessary steps to find a suitable learning path. It is an effective method for students to analyze themselves and better understand their personality. It also helps students work on themselves and overcome their shortcomings. In particular, it is important for identifying their learning interests and finding appropriate pathways aligned with them.

3. Lecturer (Professor–teacher). In developing the professional training of future software engineers, the support of the professor–teacher is highly important. In this regard, the student is also required to be aware of the following information:

1) Detailed information about the professor–teacher's subject and field. This helps the student understand in which discipline and research area the teacher conducts studies;

2) The professor–teacher's work experience. This includes their professional activity, the subjects they have taught, and the scope of their scientific research topics;

3) Work schedule and timetable. This is important for effective cooperation, helping students know working days, holidays, and availability;

4) Learning process and class schedule. Students become aware of the lessons conducted and the timetable structure;

5) Personal contact information for consultation and communication. This helps students contact the teacher directly to resolve questions;

6) Teaching methods used with students. This provides information about how the teacher interacts with students and manages the learning process;

7) Assessment system and rules. This helps students understand grading criteria and requirements for coursework and activities;

8) Availability of certificates or diplomas required for teaching in foreign languages. This indicates whether the teacher is qualified to conduct instruction in foreign languages.

These important elements help effectively utilize the professor–teacher's role in developing the professional training of future software engineers.

4. Group work. The development of students' group work skills enhances their professional training. Through group work, students can increase their experience

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related to future professional activities. It allows them to compare their experience with other students, identify their own learning directions, and acquire new skills. This is an essential quality for active participation in society, and the role of this component in building a future professional career is highly significant.

5. Use of modern technologies. In developing the professional training of future software engineers, it is necessary to use modern technologies such as the internet, social networks, and e-pedagogy opportunities. Modern technologies have made the learning and teaching process more convenient and faster. Through the internet, students have the opportunity to access knowledge from anywhere in the world, which contributes to the formation of their professional competencies. Such resources are very important for providing students with more knowledge and practical experience.

6. Self-rewarding. This refers to using several approaches to increase students' motivation. For example, they can be encouraged to achieve success by creating healthy competition among themselves. To do this, they should review their past achievements and incomplete successes and work on improving them.

The introduction of programming languages into the teaching of mathematics in educational institutions also contributes to the development of interpersonal communication among learners and ensures the successful implementation of both professional and socio-cultural activities. In this regard, the use of modern programming languages in performing mathematical operations increases the effectiveness of preparing future software engineers for mathematical activities. In addition, it supports their ability to adapt dynamically to societal changes and develops creative and professional abilities.

In this regard, it is important to identify the impact of programming languages in the process of developing professional competence of future software engineers. Contradictory opinions regarding the use of programming languages in the educational process are as follows:

Insufficient skills in effectively using programming languages for independently acquiring new knowledge in mathematics.

Although there is a need to develop professional competence among students in higher education institutions, there is a lack of adequate pedagogical conditions for learning programming languages.

Ensuring interdisciplinary connections in education is an important condition for developing the professional readiness of future software engineers. This involves

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continuity and interrelation in teaching, as well as the development of mathematical concepts within new educational approaches. Practical problem-based content plays a significant role in achieving interdisciplinary integration. Firstly, it helps students implement mathematical function modeling. Secondly, the use of mathematical knowledge in solving practical problems enhances their ability to apply it in the learning of other disciplines.

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