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Lessons in Improving the Methodology of Teaching Mathematics

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Lessons in Improving the Methodology of Teaching Mathematics

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Abstract: This article explores modern approaches to organizing lessons aimed at enhancing the methodology of teaching mathematics in higher education institutions. It emphasizes the significance of developing core competencies in students, clarifying their purpose and importance. In today’s educational environment, the competence-based approach is considered highly relevant, as it enables students to acquire the essential knowledge, skills, and qualifications needed for effective application in their personal, social, and professional lives.

INTRODUCTION

The Presidential Decree of the Republic of Uzbekistan No. PD-4433, dated August 30, 2019, titled *"On measures to attract young people to the field of science and engineering, support their initiatives, and improve the education system,"* serves as a foundation for the initiatives discussed in this article. The implementation of tasks outlined in this and other relevant legal and regulatory documents supports the development of education in line with national priorities.

Within this context, designing the development process of fundamental and scientific competencies becomes essential, and it directly influences the selection of appropriate teaching methods. Regarding the competence-based approach, scholars such as D. B. Elkonin highlight the inherently social nature of educational activities. He asserts that education leads to significant personal transformation in students, shaped by various motivations, and must contribute not only to the acquisition of knowledge and skills but also to the formation of competencies.

The competencies targeted for development in students vary depending on their nature and specific objectives. For instance, it is crucial to distinguish between subject-specific (educational) competencies and broader (general) competencies. Educational competencies are designed to reflect and prepare students for their future life roles and can be instrumental in addressing real-world problems [1.5]. In the process of enhancing the methodology for teaching mathematics in higher education institutions, particular attention must be given to refining the methods used during classroom instruction.

EXPERIMENTAL RESEARCH

Currently, the competency-based approach in higher education emphasizes that students should acquire the essential knowledge, skills, and competencies needed for effective application in their personal, social, and professional lives throughout their education. The perspectives of scholars such as I.S. Sergeyev and B.P. Blinova on the potential of this approach are particularly relevant [3.6.].

This approach fosters students’ responsibility and awareness towards their education, facilitates the teacher’s role, and aligns students' objectives with the overarching educational goals set by instructors. It also prepares students to handle unexpected real-life situations, promotes coherence between theoretical lessons and practical application, and demonstrates how classroom concepts can be utilized in everyday life. Furthermore, emphasis is placed on the student’s ability to adapt and apply knowledge in diverse contexts.

The practical implementation of the competency-based approach can be categorized into four areas: basic competencies, which encompass foundational skills including pedagogical technologies and information processing techniques; generalized scientific skills; practical application of scientific knowledge; and life skills that support everyday functioning [1.7.].

Thus, the competency approach is recognized as a crucial element of higher education, especially in cultivating science-related competencies among students. It necessitates creating conditions that enable learners to acquire, internalize, and apply knowledge using modern educational methods throughout their lives.

Educational competence refers to a student's knowledge, skills, qualifications, work experience, motivation, logical reasoning, interests, and value orientation—all essential for effective functioning in real-world settings. Competence integrates knowledge, skills, abilities, personal traits, outcomes, and systematic engagement, underscoring the need for an education system grounded in this approach.

Higher education curricula are designed to develop core competencies that reflect contemporary demands, including communicative competence, information literacy, self-development, socially active citizenship, national and universal competencies, mathematical literacy, awareness of scientific and technological advances, and the capacity to foster innovative thinking in students [4]. This approach encourages active, purposeful learning, enhances information processing, communication, educational and cognitive abilities, nurtures personal potential, promotes self-confidence, and cultivates self-management skills.

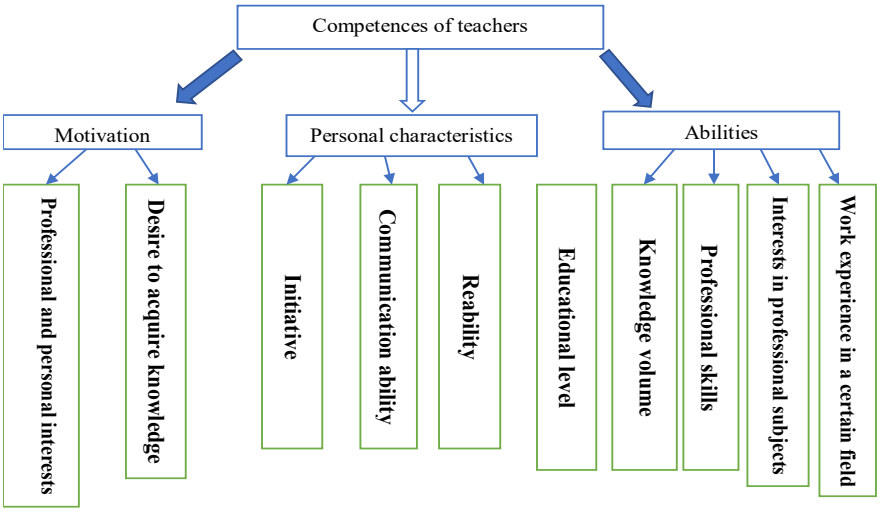

FIGURE 1. Interconnection of the components of student competence.

A student's capabilities are reflected through their competence. The combination of a student's traits, motivation, and abilities can be represented as a vector and analyzed as an integrated set of knowledge, skills, qualifications, and professional competencies

As discussed above, the various perspectives on the concept of competence indicate that it should be understood as a multifaceted structure. This structure encompasses several components: the acquisition of essential knowledge, skills, and qualifications; personality traits that influence the ability to carry out specific tasks; a set of professional attributes; and the development of relevant individual competencies.

The educational process is a specifically organized and regulated activity that coordinates and guides students' learning efforts. It consists of five fundamental elements [49]:

1. The purpose of education – why teaching is necessary;
2. The content of education – what knowledge and skills should be taught;
3. Methods of education – including pedagogical techniques and forms of communication;
4. The educator;
5. The student.

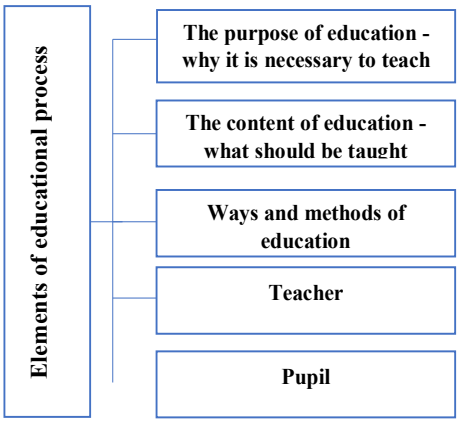

FIGURE 2. Elements of the educational process.

Student engagement is a fundamental factor in mental development. It is important to highlight that this development is largely shaped by the type of activity—such as communication, play, study, or work—which influences the content of the student's unique psychological traits and cognitive processes. This development is most effective when it occurs through interaction with adults and under their direct supervision. Several principles guide the planning of lessons related to the specific departments within higher education institutions.

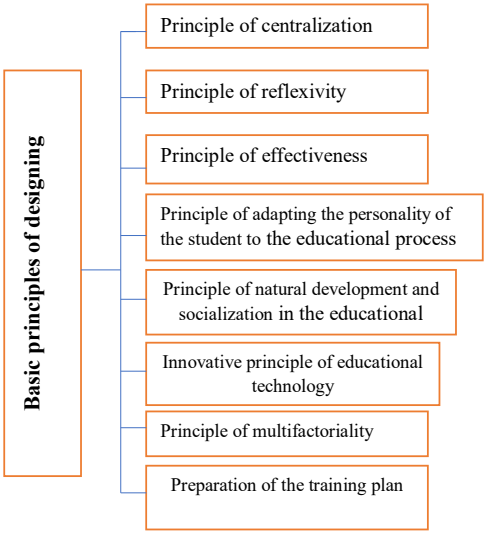

FIGURE 3. The key principles of lesson design are as follows

Students should be able to interpret the principles and key directions of development reforms, understand our country's position within the global community and its developmental stage, and apply various formulas, models, drawings, graphs, and diagrams in everyday tasks. These fundamental competencies are then integrated into the teaching of academic subjects. Curriculum plans are structured accordingly [5.9].

The competency-based approach calls for a stronger practical orientation throughout higher education. Consequently, the teacher's role must evolve, with the primary goal of fostering students' ability to independently expand their knowledge, take initiative, and develop skills for collaborative living and learning. In today's fast-paced world, society requires educated, ethical individuals who stay informed about current events and possess the following qualities:

it is necessary to be able to analyze actions; to be able to analyze the results of all actions, to be able to make independent decisions; fast operation; ability to work in cooperation; it is necessary to cultivate a sense of responsibility for the fate of the country, its socio-economic prosperity.

TABLE 1. Didactic-methodical requirements for classes.

Teaching didactic requirements	Traditional lecture training	Modern lecture training
Announcement of the content of the lecture	Told by the teacher	Formed by students
Telling the goals and tasks	What students learn is shaped and told by the teacher	Students participate in classes knowing what they know and what they don't know
Planning	The teacher tells the students what they need to do to achieve the goal	The methods of achieving the intended goal are planned by the students
Practical activity of students	It is performed by students under the guidance of the teacher	Students carry out educational activities based on the established plan
Implementation of controlling	Supervises practical work performed by the teacher and students	Students monitor (self- and peer-monitored)
Student assessment	The teacher evaluates the students in the audience	The student evaluates his/her own and other students' performance
Concluding the lecture	Teacher asks students what they can remember	On the basis of mutual question and answer

According to standards based on the competency approach, it is essential to enhance students' curiosity about the world, encourage the search for useful information, and strengthen their readiness to apply this knowledge in real life. Consequently, the roles and activities of both teachers and students evolve during the preparation and delivery of modern lessons. The most common form of instruction remains the lesson.

To prepare an effective modern lesson, teachers should focus on the following:

- Defining clear goals and objectives
- Selecting relevant educational content
- Choosing appropriate teaching methods
- Identifying suitable assessment techniques [10]

Lessons should stimulate student engagement by presenting problematic and challenging situations, encouraging learners to draw their own conclusions. Personal initiative can lay the foundation for developing students' independence, making it vital to create conditions that allow them to take active roles in their learning. Students should be able to graphically represent texts they have read, solve problems using established rules, and explain concepts to their peers. When intellectually capable students take confident steps in new environments, they are more likely to achieve their goals [4].

Competence in mathematics involves the ability to apply learned knowledge, cultivate interest in technical creativity, and develop skills necessary for both practical and innovative activities in daily life. Communicative competence in higher education includes improving oral and written expression, providing structured responses to questions, clearly articulating opinions, working effectively with supplementary literature, designing tests and questions, collaborating in groups, defending viewpoints, persuading others, and practicing self-management. Additionally, proficiency in foreign languages alongside the native language is encouraged.

To build communicative competence, consistent work with textbooks is necessary, including skills such as comprehending texts, answering questions related to the topic, completing practical assignments, and constructing electrical circuits and graphs based on topic materials. Emphasis on self-study through tasks, tests, educational videos, and independent research from additional literature and online sources fosters the development of self-directed learning among future technical specialists, aiming for their intellectual maturity and preparedness for societal demands.

The purposeful, exemplary, and effective organization of lesson activities is one of the key factors determining the quality of the educational process. This process largely depends on the perfection of educational and methodological support, the teacher's deep knowledge and methodological preparation in the subject, as well as their pedagogical skills and the culture of interaction with students during the lesson. In particular, in general secondary schools, the successful organization of lesson activities significantly relies on teachers' thorough pre-planning and pedagogical design of lessons (7.10).

The introduction of modern technologies into the educational process significantly increases lesson effectiveness. Among these, STEAM educational technology is considered one of the most effective methods to enhance students' interest in sciences by ensuring interdisciplinary integration. The STEAM (Science, Technology, Engineering, Arts, Mathematics) approach enables students not only to acquire theoretical knowledge but also to reinforce it through practical activities. In this approach, the learning process involves not only cognitive (mental) activity but also motor (manual) activity.

The main distinction of STEAM education lies in its implementation of interdisciplinary integration, guiding students to combine knowledge from various fields and develop problem-solving skills based on that knowledge. This contributes to enhancing students' independent thinking, creativity, and practical skills. Moreover, STEAM education increases student engagement in the learning process because they discover, test, and create knowledge themselves. As a result, education becomes an active participation process that not only imparts knowledge but also helps in deeply and firmly mastering it.

In conclusion, for effective organization of lesson activities, high-quality educational and methodological support, professional teacher competence, and the use of modern pedagogical technologies, including STEAM education, are of great importance. This contributes to increasing students' interest in subjects, strengthening their knowledge and skills, and improving the quality of education.

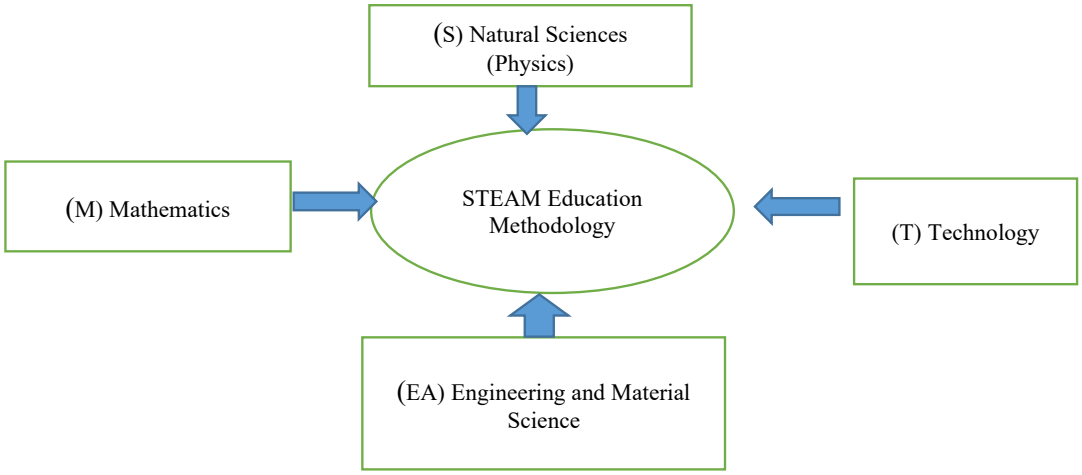

FIGURE 4. Structural Composition of Interdisciplinary Integration in the STEAM Method

For example, the diagonals of a rectangle can be related to the process of constructing a house foundation. Understanding and solving this process is based on real-life situations, which enriches students' imagination and ensures effective use of visual aids during lessons [79, 83, 87].

To make lessons engaging, each problem should not be presented as dry text but designed to stimulate higher-order thinking skills of students using a heuristic method. In this approach, students thoroughly understand the problem statement, formulate expressions or equations based on the conditions, solve the problem, and verify the results. They identify what is known and unknown in the problem, analyze the conditions, check if similar problems have been solved before, and evaluate whether previous solutions can be applied to solve the new problem. This approach effectively develops students' creative thinking and problem-solving skills.

Another form of logical reasoning is drawing conclusions. This process involves deriving a new result from two clear and strict premises. For instance, the diagonal of a rectangle divides it into two triangles, and the sum of the interior angles of each triangle is 180°. Therefore, the sum of the interior angles of the rectangle is 360° — this is the conclusion.

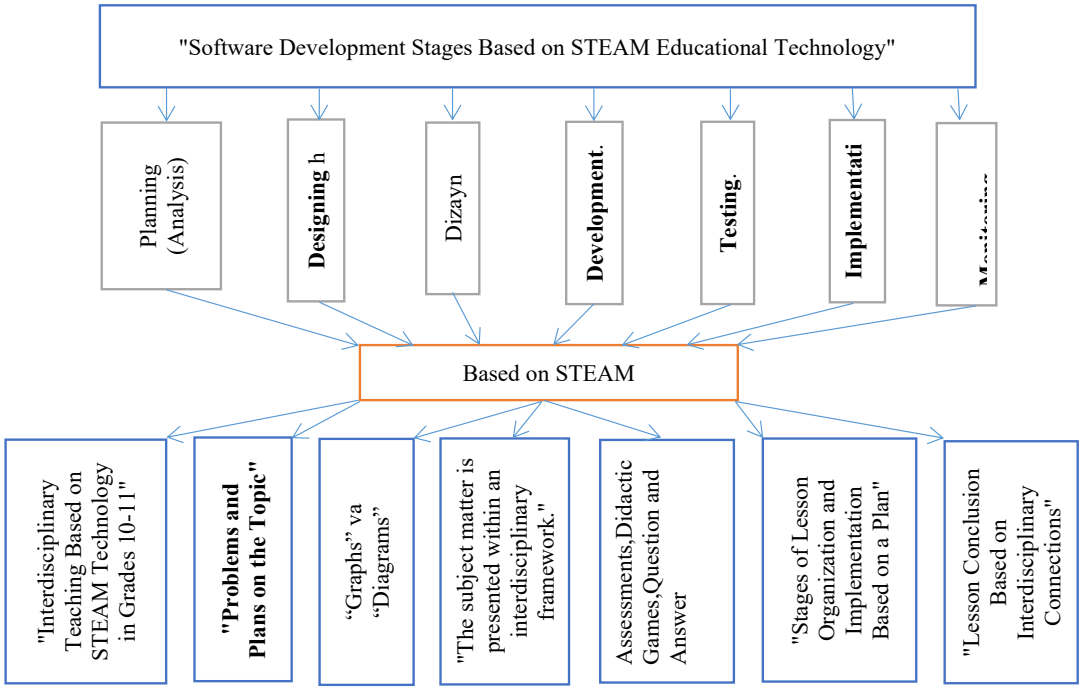

FIGURE 5. Another widely used method in the educational and upbringing process is as follows.

In general secondary schools, the core of lesson conduct represents a methodological system composed of several elements, including the lesson's objective, content, form, method, tools used during the lesson, the student and teacher roles, and lesson plans (the extended technological map of the lesson). These structural elements interact cohesively and interdependently to reveal the overall essence of the educational process.

TABLE 2. Results: Responses to the final questions were evaluated using the results of both test assessments and summarizing instructional activities.

Academic Year	Number of Students, persons	Experimental Group				Number of Students, persons	Control Group			
		Assessment Criteria					Assessment Criteria			
		Level I (High)	Level II (Medium)	Level III (Low)	Level IV (Unsatisfactory)		Level I (High)	Level II (Medium)	Level III (Low)	Level IV (Unsatisfactory)
EE	**77**	16	48	12	1	**76**	10	25	32	9
	%	21	62	16	1	**%**	14	38	34	15
KIM TEX	**76**	17	48	10	1	**77**	9	27	33	8
	%	22	63	13	1	**%**	12	35	43	10
HFX	**76**	22	43	11	0	**77**	11	27	29	10
	%	29	57	14	0	**%**	14	35	38	13
Total.	**229**	55	139	33	2	**230**	30	79	94	27
	%	24	61	14	1	**%**	13	34	41	12

The answers to the final questions are the results of the test and summative exercises.

Based on these results, the level of knowledge of the experimental and control groups is shown in the diagram below. This can also be seen in the diagram of students' theoretical knowledge acquisition levels.

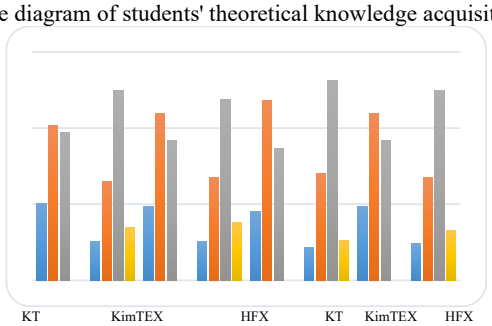

FIGURE 6. Another widely used method in the educational and upbringing process is as follows.

A thorough and comprehensive study of mathematics was conducted by employing modern educational tools and active teaching methods within the framework of the competency-based approach. Specifically, this approach fostered students' independent learning and cognitive engagement, facilitated the organization of autonomous work, and encouraged the effective use of both traditional and innovative active teaching strategies. As a result, students' educational activity and interest in science were enhanced, their motivation to learn increased, their logical thinking skills improved, and overall learning outcomes reached a high level of effectiveness.

CONCLUSION

The educational process in higher education institutions is structured based on several key conditions, which include:

- The student's need for education, whether social or personal;
- The motivation to learn;
- Defining the content of the student's activities;
- Managing student engagement and actions;
- Designing the overall educational process.

The significance of lesson plans in organizing the educational process for mathematics in higher education is unmatched. It has been established that effective planning is a crucial factor for organizing the educational process and achieving its success, and this principle has been actively incorporated into the teaching process.

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