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THE IMPORTANCE OF COMPETENCE BUILDING THROUGH INTEGRATED MATHEMATICS EDUCATION

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ВАЖНОСТЬ ФОРМИРОВАНИЯ КОМПЕТЕНЦИЙ ПОСРЕДСТВОМ ИНТЕГРИРОВАННОГО МАТЕМАТИЧЕСКОГО ОБРАЗОВАНИЯ

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Abstract. This article examines the importance of integrated mathematics education in the formation of professional competencies of future teachers. The study focuses on updating the content of education, developing students' critical thinking, research and practical skills. The effectiveness of using STEM and CLIL technologies in the teaching process is shown, and the role of interdisciplinary connections and practice-oriented tasks in shaping the ability to use knowledge in real life is revealed. The article provides theoretical foundations, methodological approaches and practical examples of integration lessons. The results of the study emphasize the importance of developing mathematical and functional literacy, increasing motivation to learn, and developing students' creative and research abilities. In addition, integrated learning has been proven to promote the development of digital, creative, social, and leadership skills. This approach activates the learning process, increases

Аннотация. Рассматривается значение интегрированного обучения математике в формировании профессиональных компетенций будущих учителей. Исследование посвящено обновлению содержания образования, развитию у студентов критического мышления, исследовательских и практических навыков. Показана эффективность использования STEM- и CLIL-технологий в учебном процессе, выявлена роль междисциплинарных связей и практико-ориентированных заданий в формировании умения использовать знания в реальной жизни. Представлены теоретические основы, методические подходы и практические примеры интеграционных уроков. Результаты исследования подчеркивают важность развития математической и функциональной грамотности, повышения мотивации к обучению, развития творческих и исследовательских способностей учащихся. Кроме того, доказано, что интегрированное обучение способствует развитию цифровых, творческих, социальных и лидерских навыков. Такой подход активизирует и повышает учебный процесс.

Keywords: integrated mathematics education, professional competence, interdisciplinary communication, STEM technology, CLIL method, applied tasks, critical thinking, practical significance of knowledge.

Ключевые слова: интегрированное обучение математике, профессиональные компетенции, междисциплинарная коммуникация, STEM-технологии, метод CLIL, прикладные задачи, критическое мышление, практическая значимость знаний.

In recent years, the education system in Kazakhstan has been undergoing significant modernization. The main goal of the ongoing reforms is to improve the quality of education through the introduction of new pedagogical technologies, the development of independent learning and critical thinking skills among students, the ability to apply theoretical knowledge in practice, as well as the training of competitive youth. The State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025 states: "Modernization of higher and postgraduate education is carried out in the context of global and interdisciplinary competencies of the 21st century (including volunteerism, civic and social responsibility, leadership, communication and research skills, business qualities, etc.), as well as in the framework of the updated content of secondary education" (https://clck.ru/3Mbg97). This is certainly becoming a priority for every team that trains undergraduates and other graduates of higher education.

In order to be a modern teacher, it is necessary not only to be able to think in a new way, but also to be able to clearly formulate problematic issues in front of students when explaining a new topic, correctly determine the teaching methodology, and also show love for the profession and students. Therefore, the teacher is faced with the task of organizing systematic and conscious work. One of the key tasks of the education system is the teaching of subjects with the formation of various competencies among students [1].

Competence is the ability to apply acquired knowledge and skills in practice, in everyday life, to solve both practical and theoretical problems. It is formed primarily in the school learning process and contributes to the strengthening of both generalized subject and applied knowledge and life skills. We believe that when preparing each graduate of a higher education institution, special attention should be paid to the formation of professional competencies such as communication, leadership, research and creative skills. According to V. A. Slastenin, the professional and pedagogical competence of a teacher is the unity of theoretical and practical training necessary to perform a professional function, expressed through the functional structure of pedagogical activity [2].

It follows from this that the author focuses on the ability to effectively apply theoretical knowledge in practice, that is, to combine it with creative activity in pedagogy. I. A. Zimnaya in her writings emphasizes that in the context of higher education reform based on a competence-based approach, the emphasis in assessing the quality of education should be shifted from the learning process to its outcome. This fully corresponds to the modern challenges of higher education. The training of a competitive specialist today is focused on achieving high results and the quality of knowledge [3].

According to B. A. Turgynbayeva, teacher training should be aimed primarily at the teacher himself, which will allow him to better understand his work, develop the ability to self-improve and reach the heights of professional creativity. This approach allows you to organize work in the "zone of immediate development" of the teacher, contributes to his professional growth and bringing pedagogical activity to a creative level [4].

The formation of a creative approach among future specialists is carried out through professional and pedagogical interaction - a system of information exchange, personal cognition and educational impact between the teacher and the student. The prerequisite for pedagogical creativity is receptivity to scientific recommendations and the experience of innovators. This becomes possible only if the graduate student understands his place in life and the meaning of his

professional activity. The pedagogical ideal begins with the student's awareness of himself as an active participant in the educational process. Pedagogical creativity requires active participation, analysis, research, the ability to identify contradictions and driving forces of the process, as well as the ability to think outside the box and make decisions in dynamic conditions. These qualities become integral features of the professional appearance of a modern specialist [5, 6].

The formation of a student's critical thinking is manifested in independent problem solving, information search and systematization, as well as in decision-making related to health, interpersonal relationships, daily life and career choice. The combination of progressive education and applied training forms the basis of practice-oriented learning.

The development of information, nano, bio and cognitive technologies in the modern world requires the synthesis of various sciences, the transformation of teaching methods, orientation towards scientific research and adaptation to changes in the environment. Therefore, a modern specialist should be critically minded, know interdisciplinary connections, and be able to solve scientific problems. All this requires adherence to the principles of interdisciplinarity and an integrative approach to learning.

Materials and research methods

Interdisciplinary learning is teaching that combines materials from several disciplines. The principle of interdisciplinary communication is aimed at forming a holistic worldview that corresponds to the current level of development of science and social practice by establishing relationships between various academic subjects**.** There are three main components of interdisciplinary connections: general concepts, laws and theories characteristic of the cycle of theoretical disciplines; general cognitive and educational skills (the ability to learn, work with information, express their thoughts); methods of scientific knowledge (observation, experiment, practice, modeling, theoretical analysis and generalization). These components make it possible to transfer interdisciplinary connections from educational situations to real-life contexts.

The main purpose of the study of integrated mathematics course teaching is to form the professional competence of future mathematics teachers by theoretically linking knowledge gained from various subjects.

The form of learning with the preservation of interdisciplinary connections is integrated learning. Integration (integrated learning) is aimed at improving natural science education, in particular, mathematics, and developing the necessary competencies among students. The integration uses STEM and CLIL technologies. Common forms of integrated lessons are sequential learning, alternating learning, and parallel learning [7, 8].

There are two types of integration: horizontal and vertical. Horizontal integration includes practice-oriented tasks that establish links between mathematics and other subjects within the same topic, and allows you to fully disclose the content of the issue under study. Vertical integration complements horizontal integration, requiring the inclusion of larger scientific and applied tasks covering the entire educational material. Professional tasks are solved in such integration [9].

Historically, STEM technology (Science, Technology, Engineering, Mathematics) is a model combining natural science and engineering disciplines. The term STEM was first proposed by the American bacteriologist R. Colwell in 1990, and it has been widely used since the early 2000s [10].

The term CLIL (Content and Language Integrated Learning), as defined by D. Marsh, is an integrated teaching of a subject and language, in which the content is transmitted in a foreign (non—basic) language. language. According to Doyle, from a methodological point of view, the content component is a system-forming element [11, 12].

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Research by foreign and Kazakhstani scientists examines in detail the use of STEM and CLIL in education, the difficulties encountered and ways to solve them. The effectiveness of robotics and software in teaching, adapted to the age characteristics of students, was particularly noted.

Foreign studies also confirm that CLIL, a technology that combines a subject and a foreign language, is one of the most effective ways to increase student motivation, as well as consistent and systematic teaching of foreign languages.

The development of necessary competencies in the process of teaching mathematics is of great importance. Integrative learning increases students' interest in the subject, develops mathematical literacy, stimulates motivation, promotes teamwork, development of independence, critical thinking and research skills.

Integrated learning is implemented through STEM and CLIL technologies, as well as the project method. Group forms of work are used to perform interdisciplinary tasks. At the same time, it is necessary to take into account: the connection of each task with real life, the impact on the economy, the relationship with the environment and everyday situations [13].

This, in turn, contributes to the development of not only research competence, but also such social and educational qualities as personal hygiene and environmental protection.

Integrative methods of teaching mathematics, the use of information technology, and the selection of assignments taking into account their connection with everyday life not only increase students' interest in the subject, but also help in choosing a future profession, and also become the basis for the formation of research competence.

The acquired knowledge in mathematics is necessary for a person in his professional activity, therefore it is important not only to ensure the assimilation and application of mathematical knowledge in solving problems, but also to develop the ability to apply this knowledge in various fields of activity.

Applied tasks are one of the means of developing such skills. Applied tasks contribute to the establishment of interdisciplinary links between mathematics and physics, chemistry, biology and other disciplines. In addition, they demonstrate the possibility of using mathematical apparatus to solve practical problems in various sciences. Thus, it can be concluded that teaching mathematical modeling contributes to the full mastery of cognitive methods and the development of intellectual activity of students. Modeling exercises develop critical and creative thinking. If the tasks can be easily checked in everyday conditions, then the examples below, in our opinion, can be considered the most optimally and interestingly designed tasks.

Task 1. To prepare 500 grams of a medical solution with a mass fraction of 20% salt, how much salt is needed?

Solution: First you need to set a goal for the task. Condition: it is required to prepare 500 g of a solution with a mass fraction of 20% salt.

At the second stage, we will create a mathematical model: Let x be the mass of salt (in grams) dissolved in water. The total amount of the solution is 500 g; the mass fraction of salt is 20%**.** Mathematical model:

$500г \leftrightarrow 100\%р$

$xг \leftrightarrow 20\%$

$$\begin{cases} 500г \leftrightarrow 100\%р \\ xг \leftrightarrow 20\% \end{cases} \Rightarrow \frac{500}{x} = \frac{100}{20} \Rightarrow x \cdot 100 = 500 \cdot 20 \Rightarrow x = \frac{500 \cdot 20}{100} = 100(г)$$

Result analysis: The solution contains 100 g of salt, then the mass of water is 500-100 = 400 g.

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Task 2. Some types of pests in the forest multiply exponentially. At the beginning of the study, their number was $2 \cdot 10^4$. After 6 days, their number doubled. If each pest eats 4 cm^2 of leaves daily, how many leaves will they eat in 20 days?

Decision: A clear algorithm is needed to solve the problem. Let's start with the question: how many leaves will be eaten in 20 days?

Mathematical model: It is known that the population grows exponentially in the absence of dietary restrictions: $N(t) = ae^{kt}$ where t is the number of days.

Since the number of pests doubled after 6 days: $N(0) = 2 \cdot 10^4, a = 2 \cdot 10^4, N(6) = 4 \cdot 10^4$

$e^{6k} = 2 \Rightarrow k = \frac{ln\,2}{6}$

We get the following function: $N(t) = 2 \cdot 10^4 \cdot e^{\frac{ln\,2}{6} \cdot t} = 2 \cdot 10^4 \cdot 2^{\frac{t}{6}}$ где t $0 \leq t \leq 20$

The total number of leaves eaten in 20 days:

$$\int_0^{20} 4 \cdot 2 \cdot 10^4 \cdot 2^{\frac{t}{6}} dt = \left. \frac{8 \cdot 10^4 \cdot 2^{\frac{t}{6}} \cdot 6}{ln\,2} \right| = \frac{48 \cdot 10^4}{ln\,2} \cdot \left(2^{\frac{20}{6}} - 1\right) \approx 5460869$$

After calculations, we get an approximate result.: 5460869 $см^2 \approx$ 546 $м^2$

As shown in the examples, the integration of tasks in mathematics lessons helps students develop healthy lifestyle skills, understand natural phenomena in the environment, and also helps to uncover the mechanisms of action of certain biological and physical processes from a mathematical point of view.

Within the framework of the school mathematics course, using the knowledge gained in geography, biology, physics and chemistry lessons, students, performing various tasks, can assess the practical significance of the acquired knowledge and learn how to apply it in real life.

The integration of mathematics teaching with natural mathematics subjects helps students to develop a respectful and careful attitude towards the environment in the future. The content of integrated learning is of a general scientific nature and requires special knowledge to comprehensively solve global global problems.

The integration of several subjects in teaching mathematics, of course, requires additional time from the teacher, constant search and high professional literacy. However, integrated lessons can significantly improve students' mathematical literacy, as well as their ability to apply information technology. The main role in teaching is played by subject literacy. Therefore, in the survey, attention was paid to the question of how important the development of subject competencies is. The respondents noted that in integrated lessons, special importance is attached to language competence, as well as the ability to think quickly, mathematical and functional literacy, memory development and comprehensive development. The main problems in conducting integrated lessons are related to the material and technical base of schools; low Internet speed.

In general, two principles of improving a student's mathematical literacy have been identified: progressive mathematical thinking and mathematical competence. Mathematical competence includes imagination, the ability to make connections, and thinking. At each level of competence, the student performs actions such as recognizing mathematical concepts, performing algorithms and calculations, the ability to connect formulas in solving various problems, as well as applying the acquired knowledge in applied tasks. In order to study the implementation of integration aspects in general education schools, STEM and CLIL technologies can be used in teaching mathematics and efforts can be directed towards improving functional literacy and creativity of students.

Integrated math teaching is more complex and time-consuming compared to traditional lessons. However, when drawing up a lesson plan, it is important to clearly define the purpose and objectives of the lesson. With a large number of students in a class, it is necessary to take into

account the need to divide into groups and subgroups, and if there are two teachers, then assign roles in advance. Materials for the lesson should be prepared in advance and information technologies should be used to digitalize them. The integrated lessons discussed in the study establish links between mathematics, information technology, physics, design, English, economics, history, and computer science. During the lesson, in addition to improving mathematical literacy, students develop digital, creative, responsible qualities, as well as flexibility, adaptability, initiative, social, intercultural skills, self-confidence, leadership skills, critical thinking, communication and collaboration skills, as well as creative abilities. It is the task of every innovative teacher not only to teach mathematics, but also to promote the comprehensive development of the student, strengthen self — confidence, develop critical thinking and leadership skills, as well as develop the necessary competencies.

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